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(54) **DISCOVERING AND PRESENTING DÉCOR HARMONIZED WITH A DÉCOR STYLE**

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G06F 3/0481 (2013.01)
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(52) **U.S. Cl.**
CPC ***G06F 3/04815*** (2013.01); ***G06F 17/30247*** (2013.01); ***G06F 17/30265*** (2013.01); ***G06Q 30/0631*** (2013.01); ***G06Q 50/10*** (2013.01)

(58) **Field of Classification Search**
CPC G06F 3/04842; G06F 3/04882; G06F 3/0484; G06F 3/0481; H04L 63/08
USPC 707/737
See application file for complete search history.

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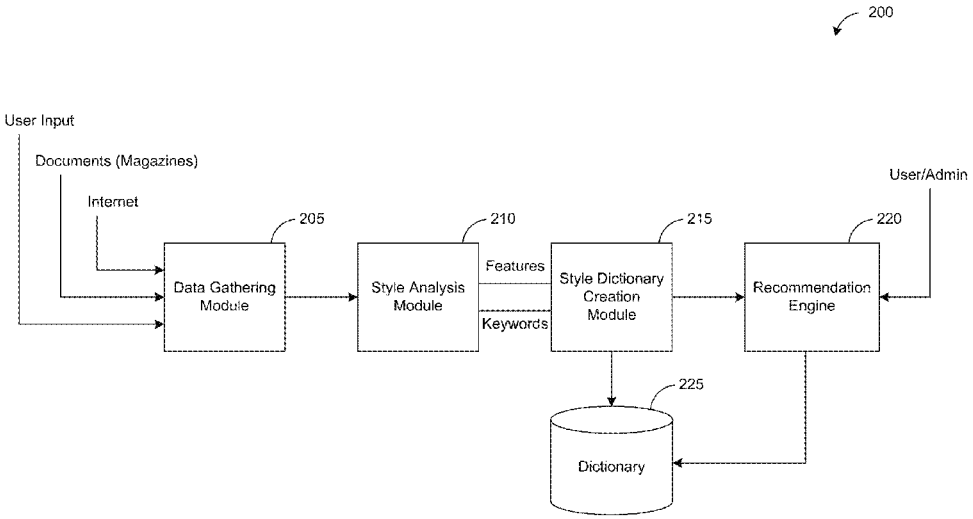
(57) **ABSTRACT**

Technology is disclosed for discovering décor harmonized with a décor style ("the technology"). The décor includes décor items, e.g. artworks, paintings, pictures, artifacts, architectural pieces, arrangement of artworks, color selection, room décor, rugs, mats, furnishings, household items, fashion, clothes, jewelry, car interiors, garden arrangements etc. The technology facilitates analyzing user input to identify a décor style from a décor style dictionary, obtaining décor that harmonizes with décor style, and presenting a representation of the décor to the user. The décor style dictionary includes décor styles that are generated based on an analysis of content, including images and description of décor, from a plurality of sources. The décor styles can be based on a number of concepts, including a theme of the décor, a color/color palette, a mood of the person, a fashion era, a type of architecture, etc. The technology facilitates presentation of discovered décor using computer generated imagery techniques.

31 Claims, 16 Drawing Sheets



(51) **Int. Cl.**
G06Q 30/06 (2012.01)
G06Q 50/10 (2012.01)

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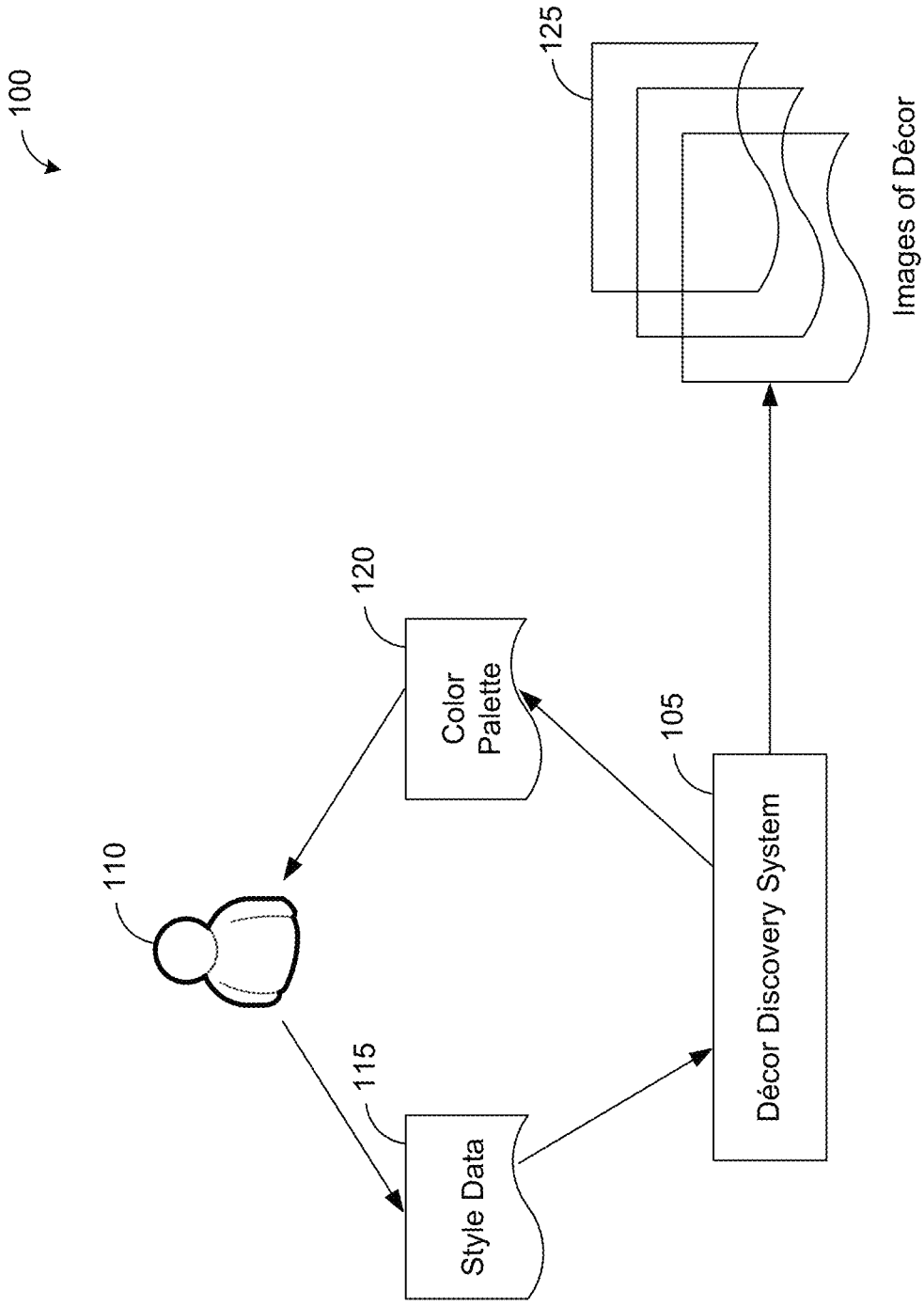
100
125
Images of Décor
120
Color Palette
105
110
Décor Discovery System
115
Style Data

FIG. 1

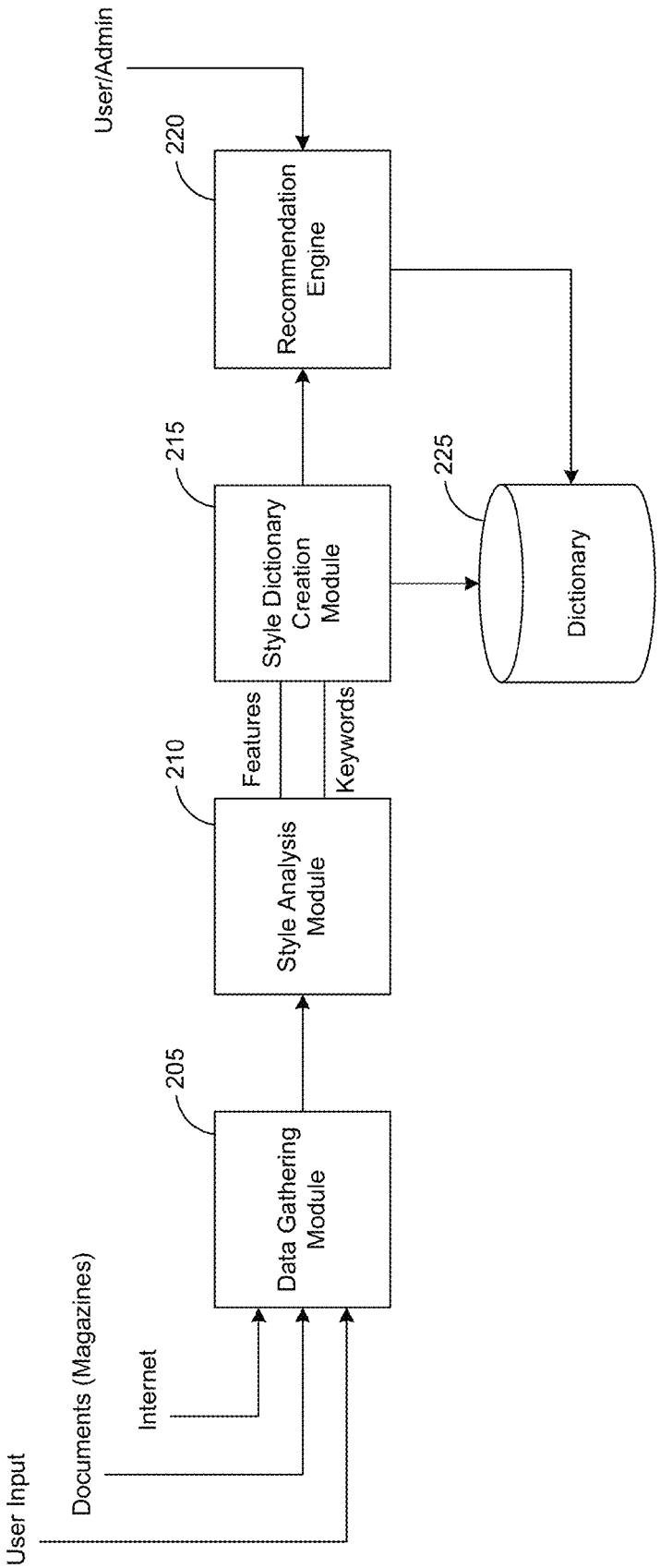
200
User/Admin
220
Recommendation Engine
215
Style Dictionary Creation Module
225
Dictionary
Features
Keywords
210
Style Analysis Module
205
Data Gathering Module
Documents (Magazines)
Internet
User Input

FIG. 2

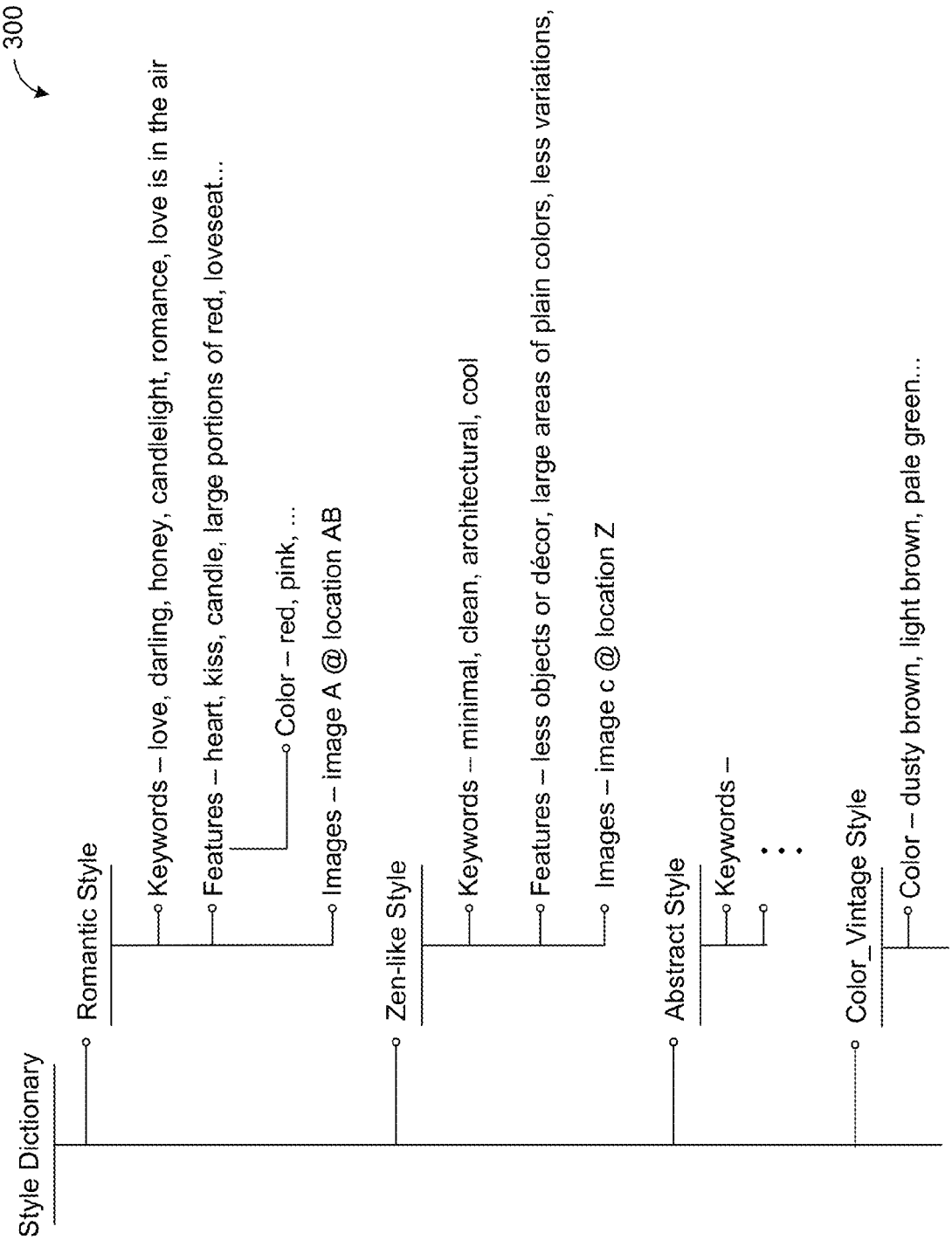
300
Style Dictionary
Romantic Style
Keywords – love, darling, honey, candlelight, romance, love is in the air
Features – heart, kiss, candle, large portions of red, loveseat...
Color – red, pink, ...
Images – image A @ location AB
Zen-like Style
Keywords – minimal, clean, architectural, cool
Features – less objects or décor, large areas of plain colors, less variations, ...
Images – image c @ location Z
Abstract Style
Keywords –
Color_Vintage Style
Color – dusty brown, light brown, pale green...

FIG. 3

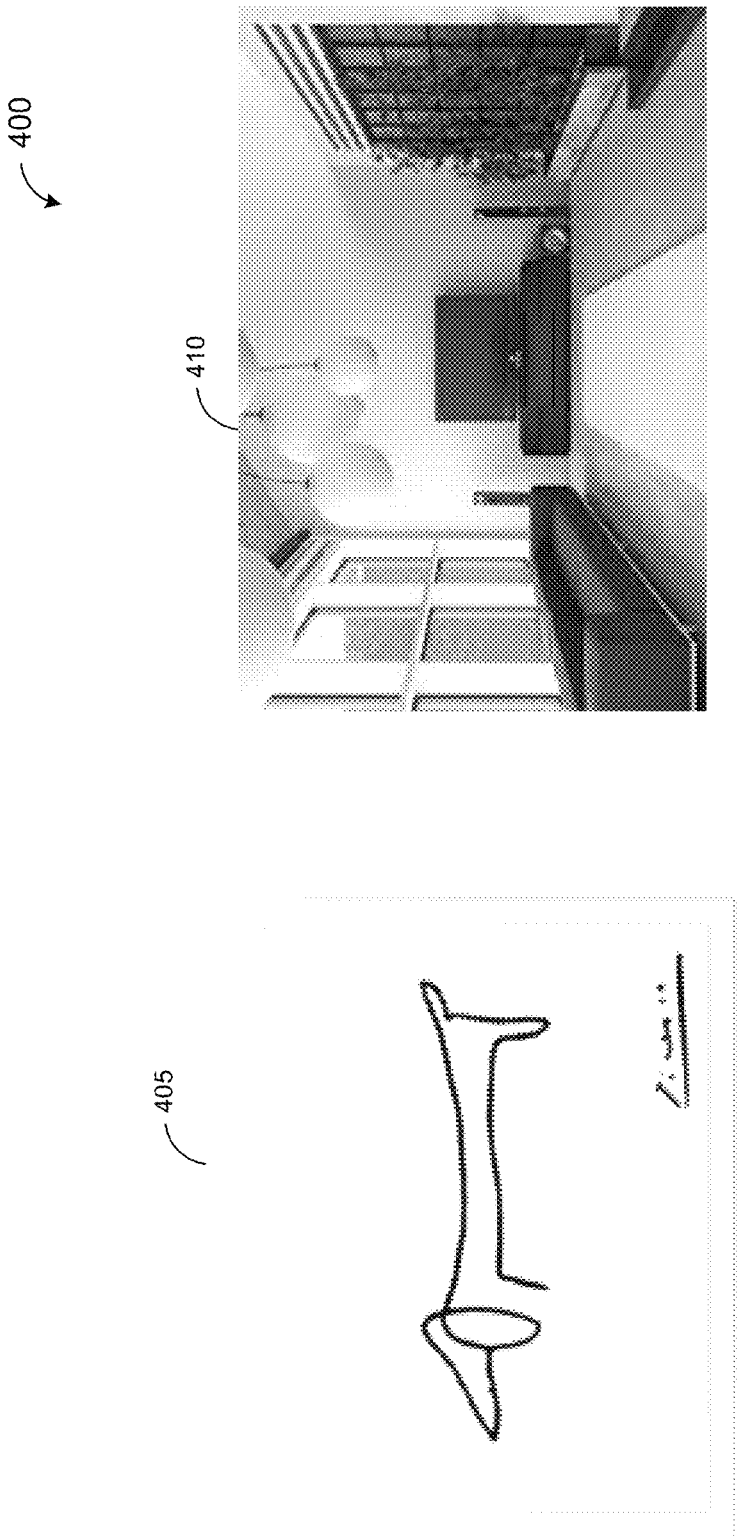
400
410
405
"Minimal" versus "Eclectic"
"Clean" versus "Busy"
"Architectural" versus "Organic"

FIG. 4

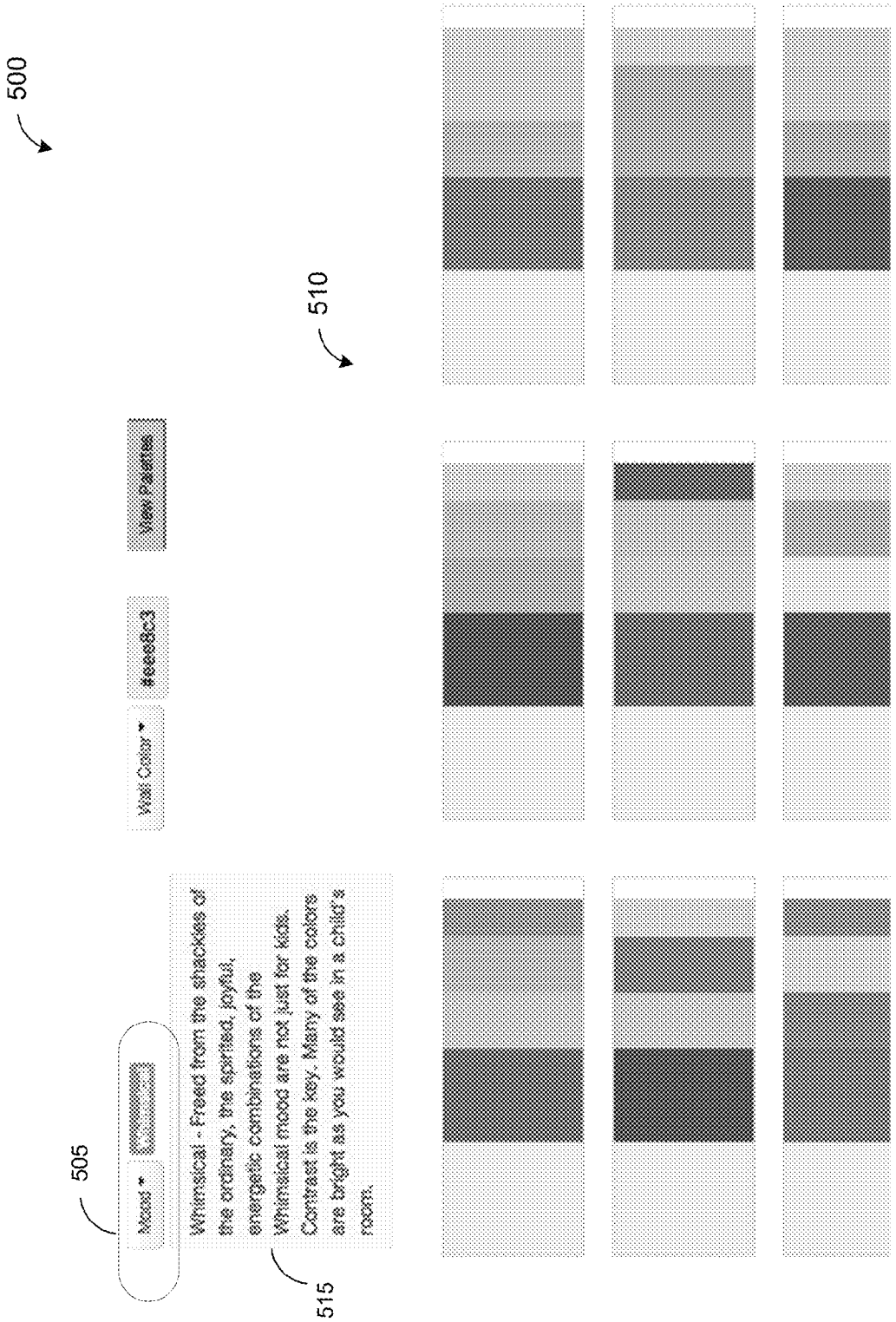
500
510
505
515
Mood *
Wall Color *
#eee8c3
View Palettes
Whimsical - Freed from the shackles of the ordinary, the spirited, joyful, energetic combinations of the Whimsical mood are not just for kids. Contrast is the key. Many of the colors are bright as you would see in a child's room.

FIG. 5

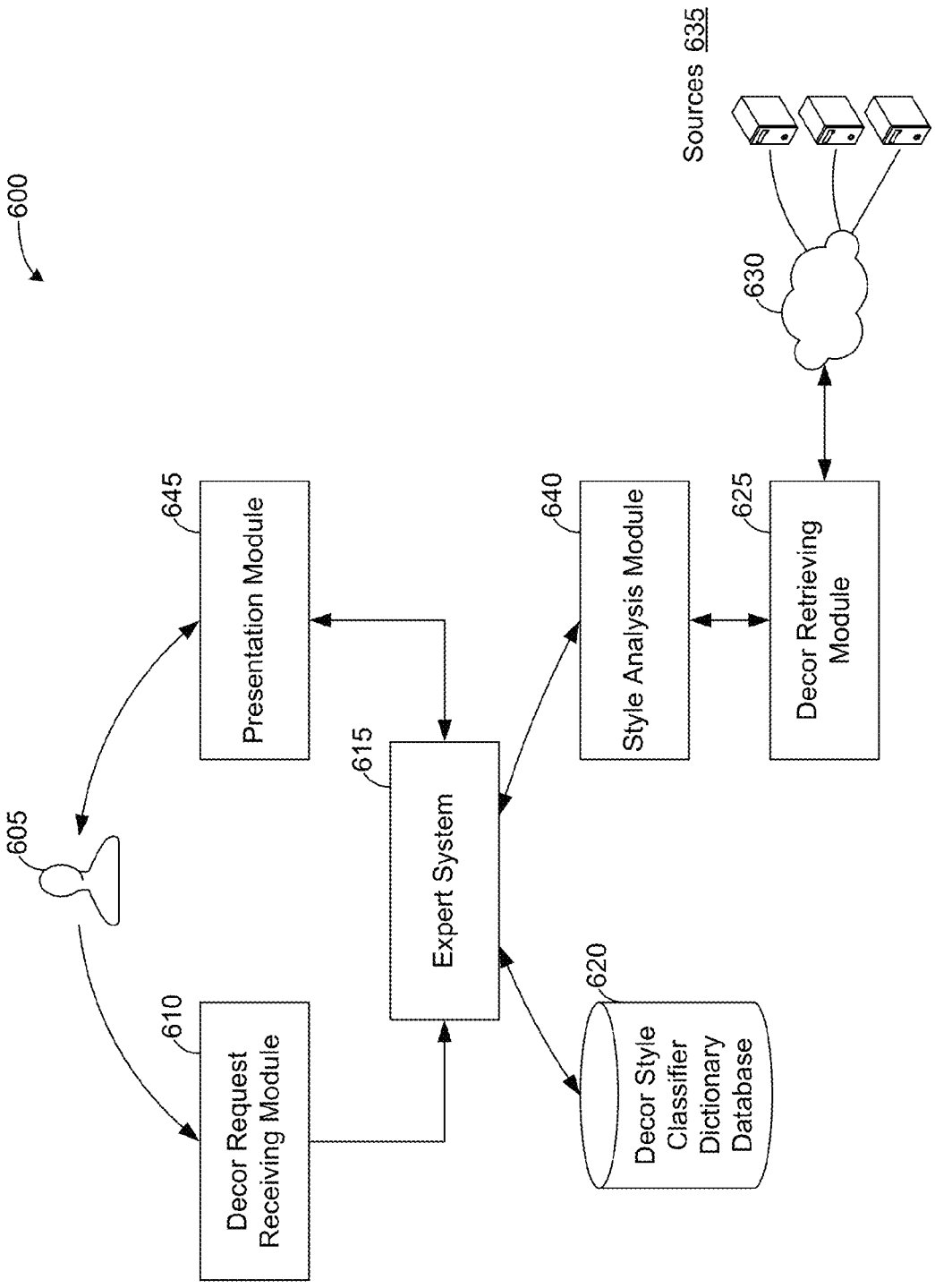
600
Sources 635
630
645
Presentation Module
640
Style Analysis Module
625
Decor Retrieving Module
605
615
Expert System
610
Decor Request Receiving Module
620
Decor Style Classifier Dictionary Database

FIG. 6

FIG. 7

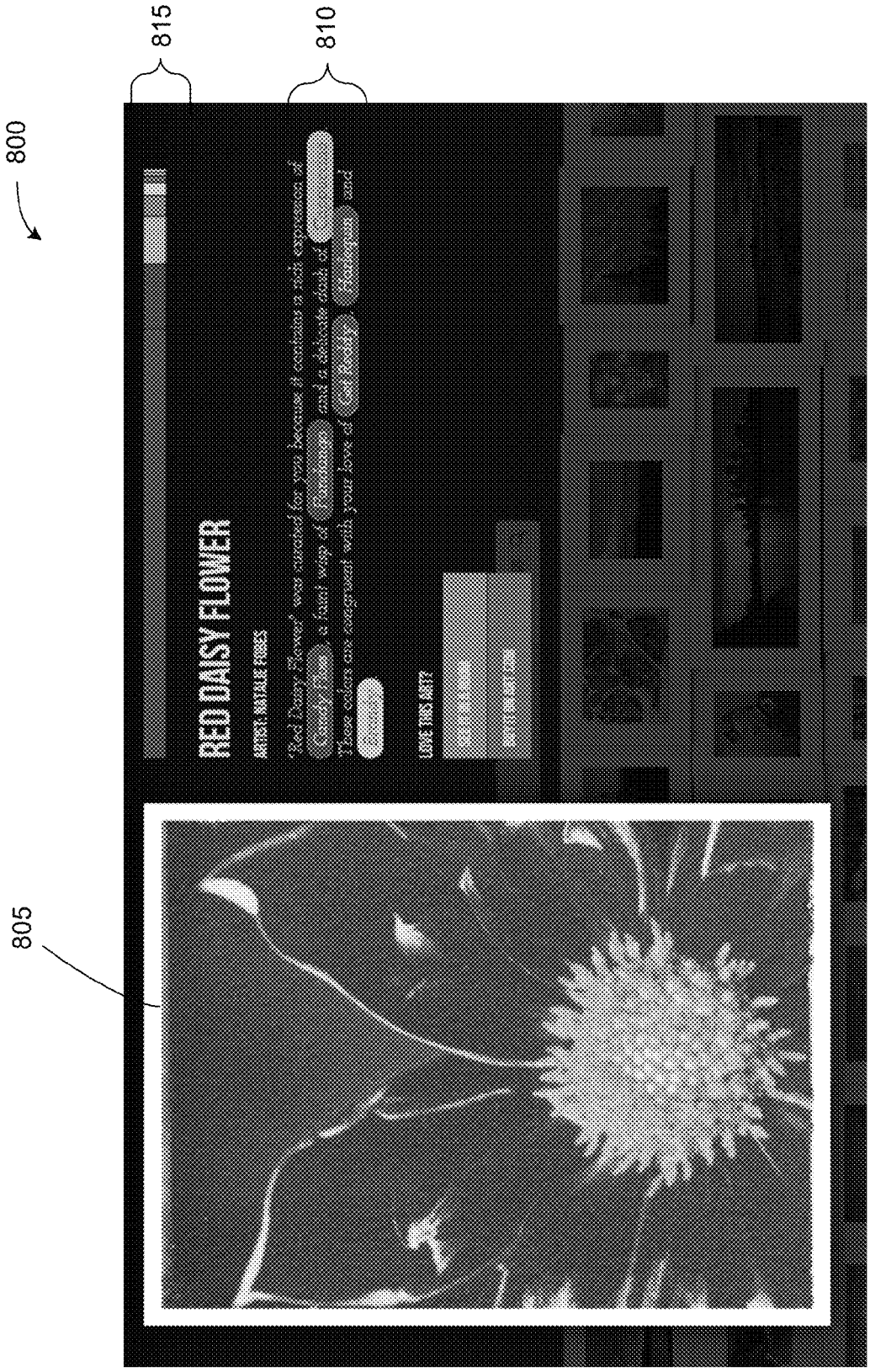

FIG. 8

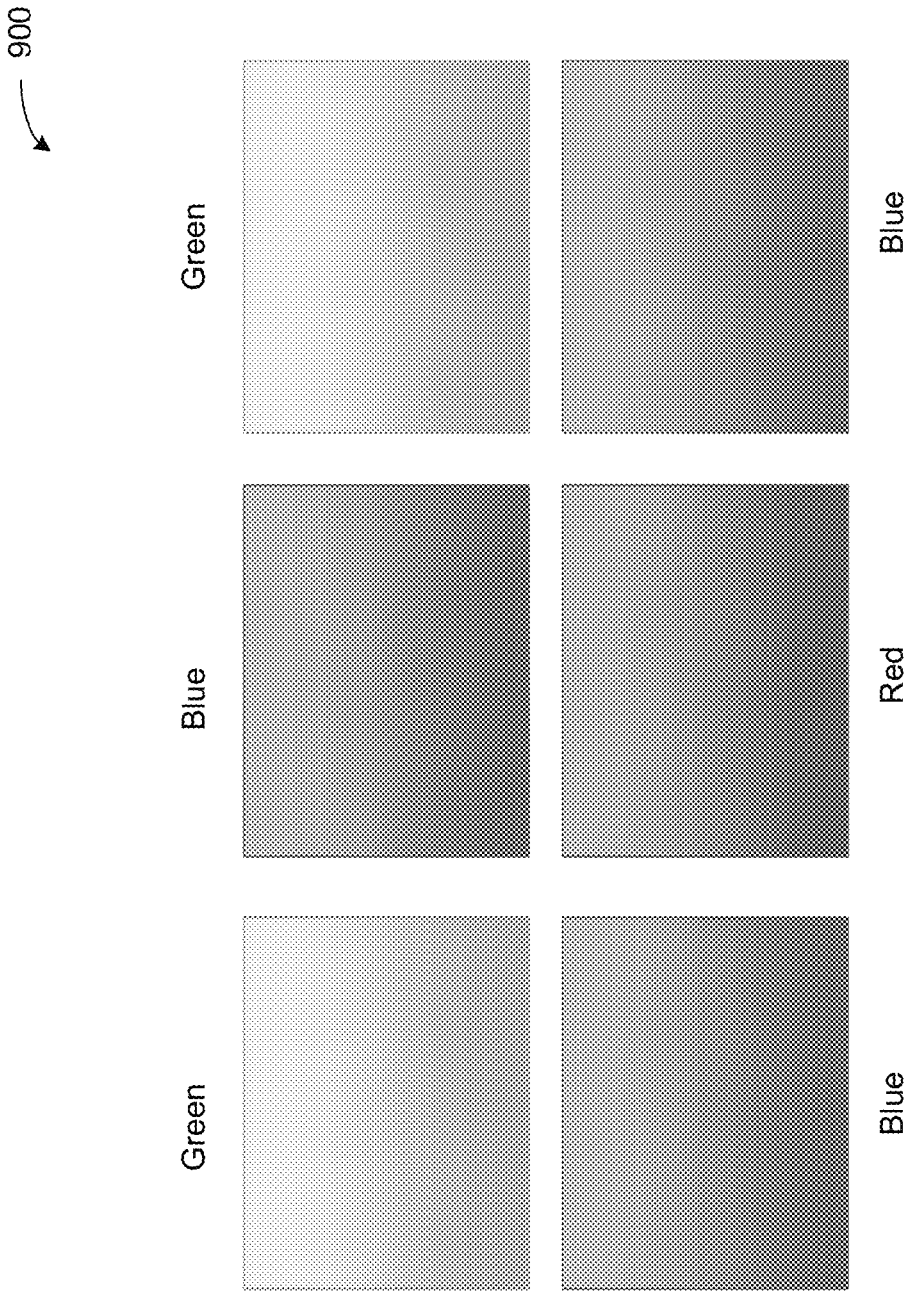

FIG. 9A

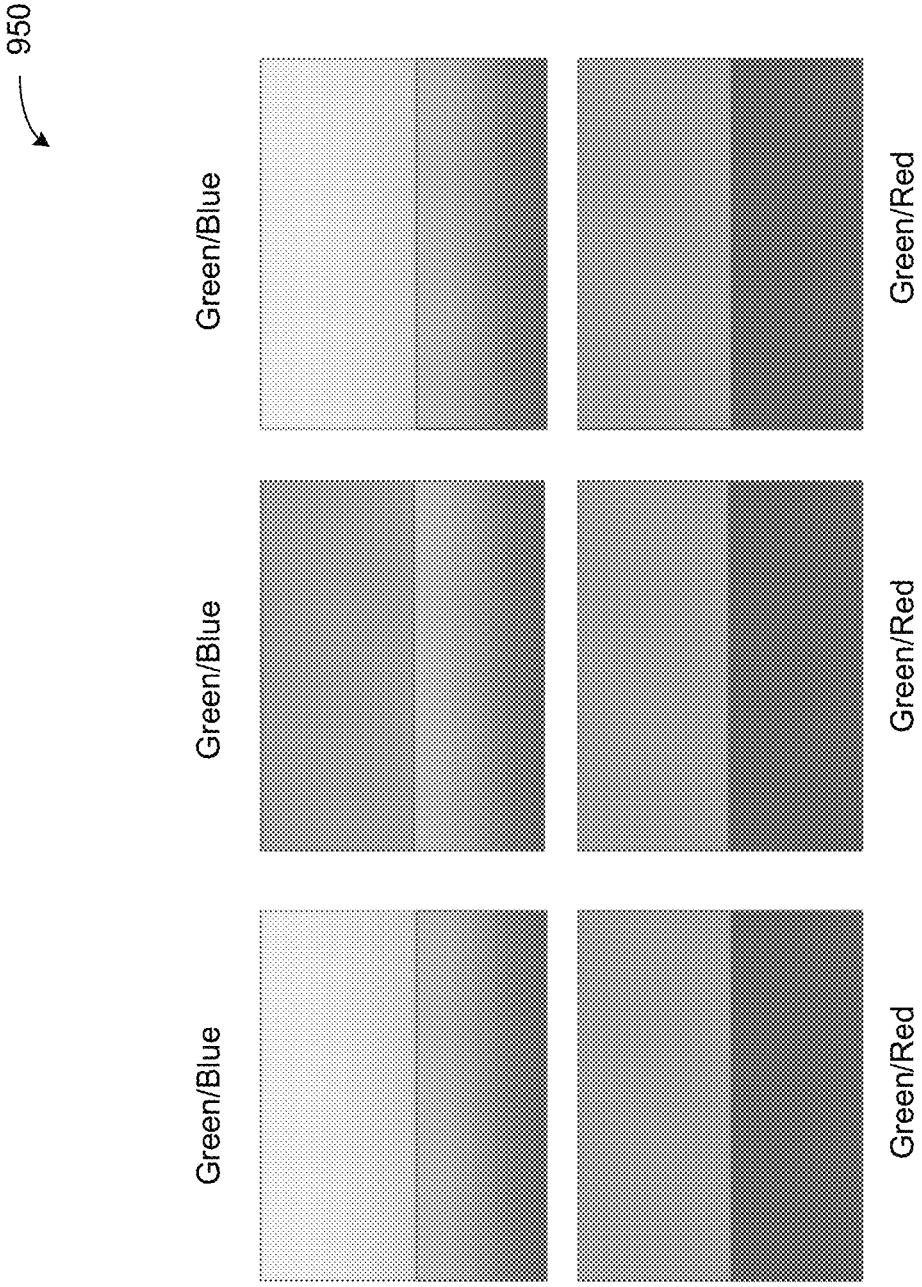
950
Green/Blue
Green/Red
Green/Blue
Green/Red
Green/Blue
Green/Red

FIG. 9B

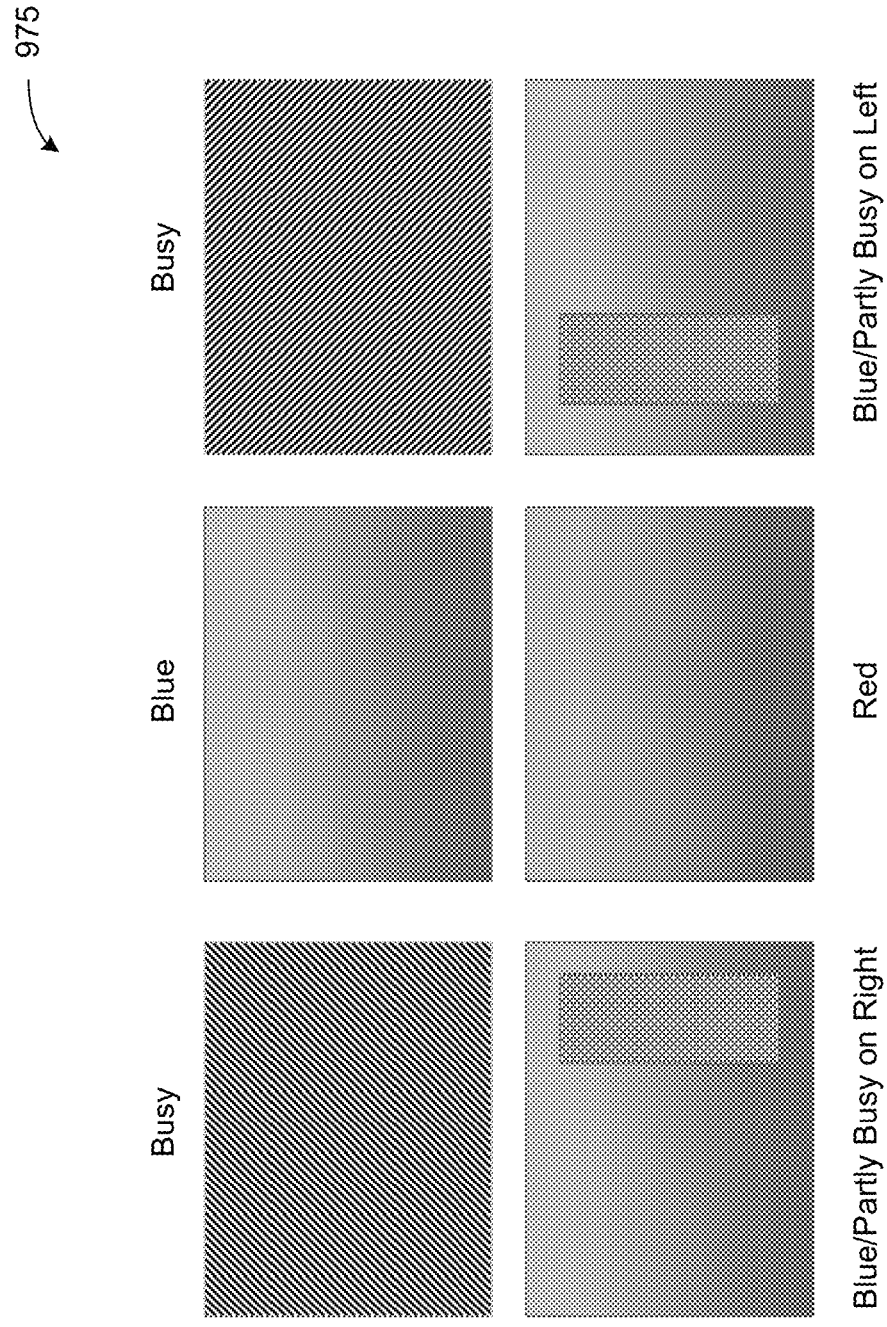
975
Busy
Blue/Partly Busy on Left
Blue
Red
Busy
Blue/Partly Busy on Right

FIG. 9C

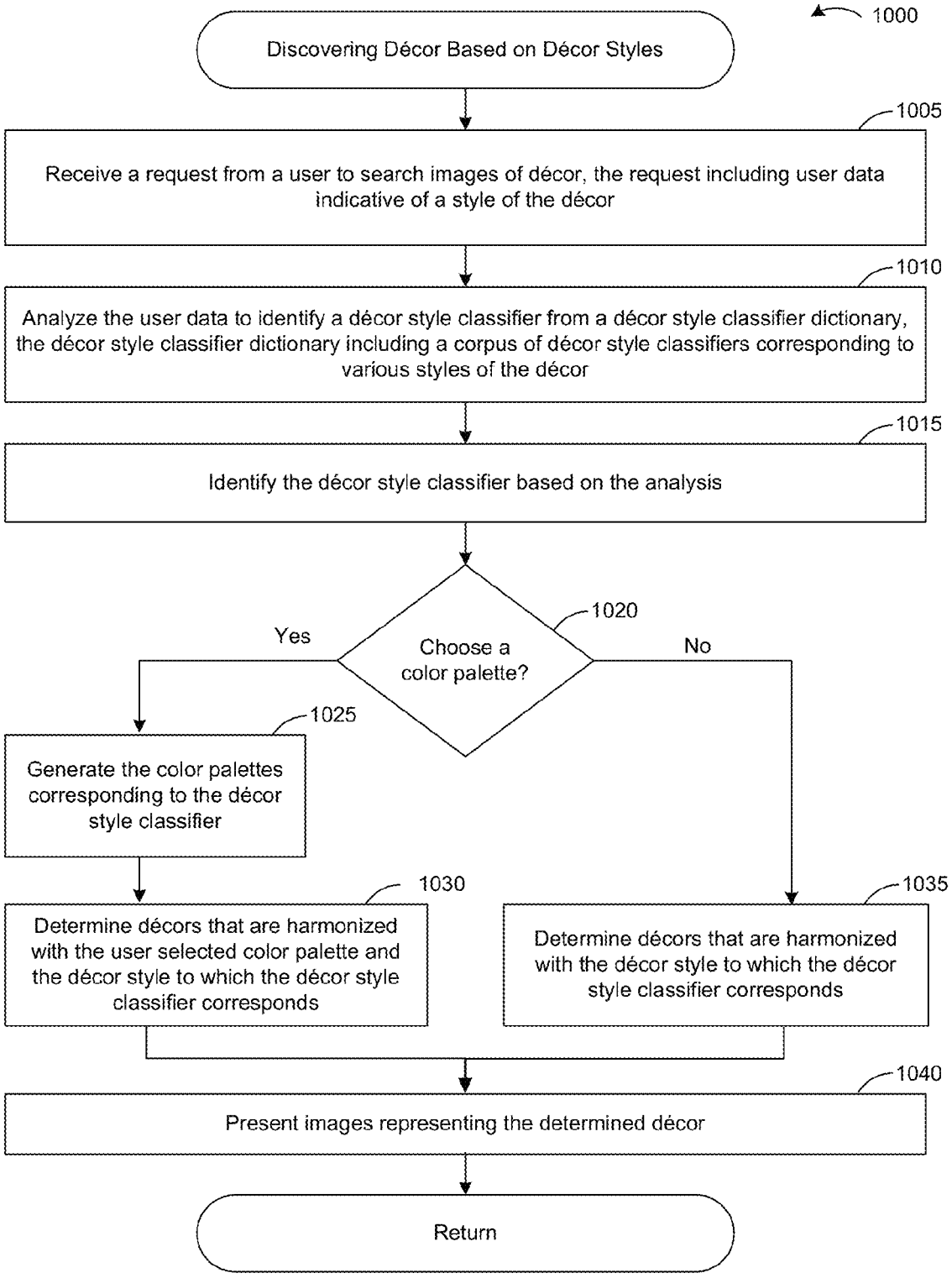
1000
Discovering Décor Based on Décor Styles
1005
Receive a request from a user to search images of décor, the request including user data indicative of a style of the décor
1010
Analyze the user data to identify a décor style classifier from a décor style classifier dictionary, the décor style classifier dictionary including a corpus of décor style classifiers corresponding to various styles of the décor
1015
Identify the décor style classifier based on the analysis
1020
Choose a color palette?
Yes
No
1025
Generate the color palettes corresponding to the décor style classifier
1030
Determine décors that are harmonized with the user selected color palette and the décor style to which the décor style classifier corresponds
1035
Determine décors that are harmonized with the décor style to which the décor style classifier corresponds
1040
Present images representing the determined décor
Return

FIG. 10

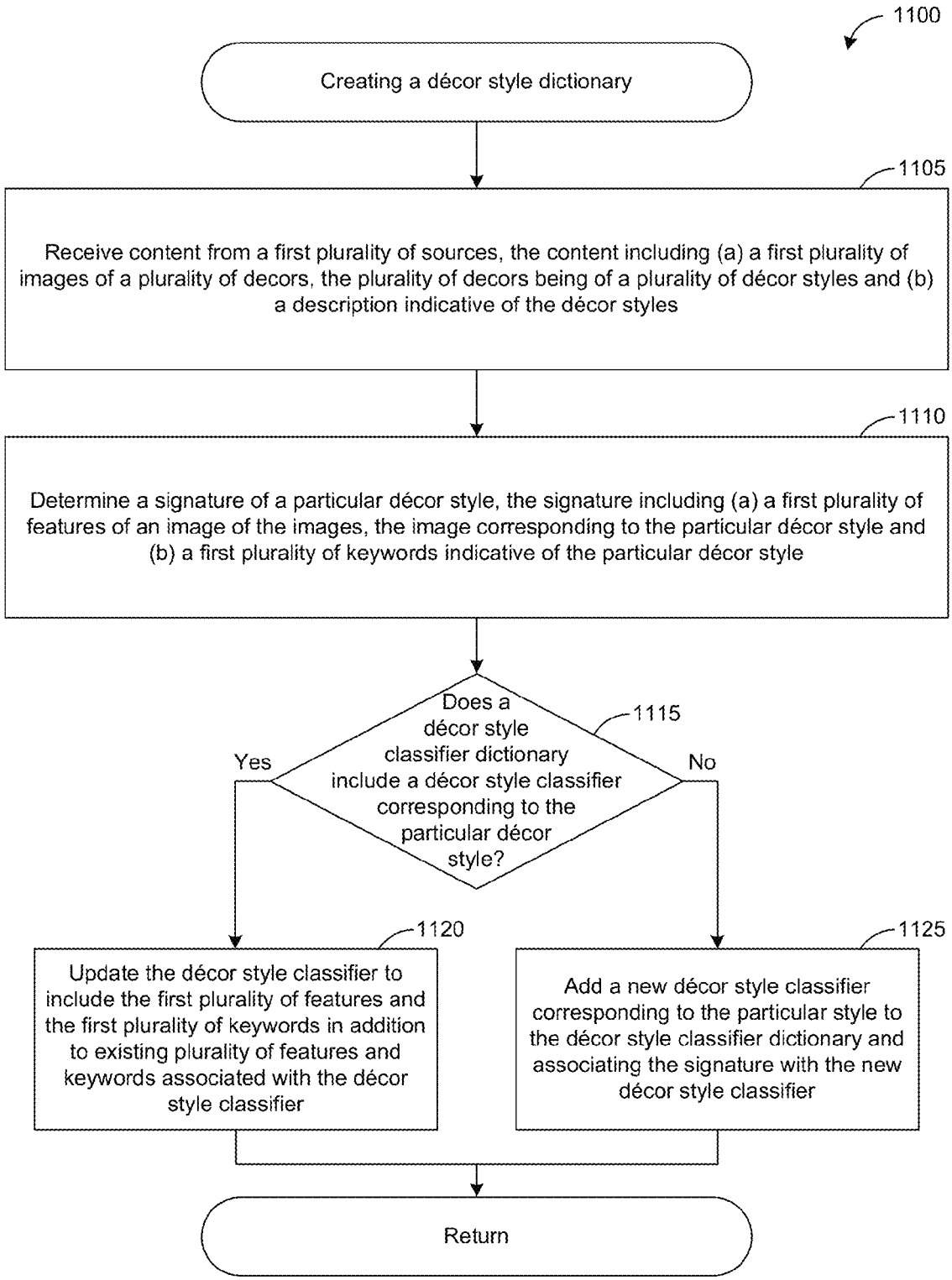
1100
Creating a décor style dictionary
1105
Receive content from a first plurality of sources, the content including (a) a first plurality of images of a plurality of decors, the plurality of decors being of a plurality of décor styles and (b) a description indicative of the décor styles
1110
Determine a signature of a particular décor style, the signature including (a) a first plurality of features of an image of the images, the image corresponding to the particular décor style and (b) a first plurality of keywords indicative of the particular décor style
1115
Does a décor style classifier dictionary include a décor style classifier corresponding to the particular décor style?
Yes
No
1120
Update the décor style classifier to include the first plurality of features and the first plurality of keywords in addition to existing plurality of features and keywords associated with the décor style classifier
1125
Add a new décor style classifier corresponding to the particular style to the décor style classifier dictionary and associating the signature with the new décor style classifier
Return

FIG. 11

1200
Associating styles to a décor style classifier
1205
Determine a set of features and a set of keywords indicative of a particular décor style to be associated with a particular décor style classifier using a rules-based expert system, the rules-based expert system including a plurality of rules for determining the décor style classifiers based on a plurality of features of a plurality of decors of a plurality décor styles and a plurality of keywords indicative of the décor styles, the set of features and the set of keywords being a subset of the plurality of features and the plurality of keywords
1210
Associate the particular décor style classifier in the décor style classifier dictionary with the set of features and the set of keywords based on the plurality of rules
1215
Track, using the rules-based expert system, style preference data of a plurality of users for the particular décor style classifier
1220
Update, using the rules-based expert system and based on the style preference data, the set of features and the set of keywords associated with the particular décor style classifier, and a weight associated with at least a subset of the set of features and a subset of the set of keywords, the weight indicating a degree of match of a particular feature or keyword with the particular décor style
Return

FIG. 12

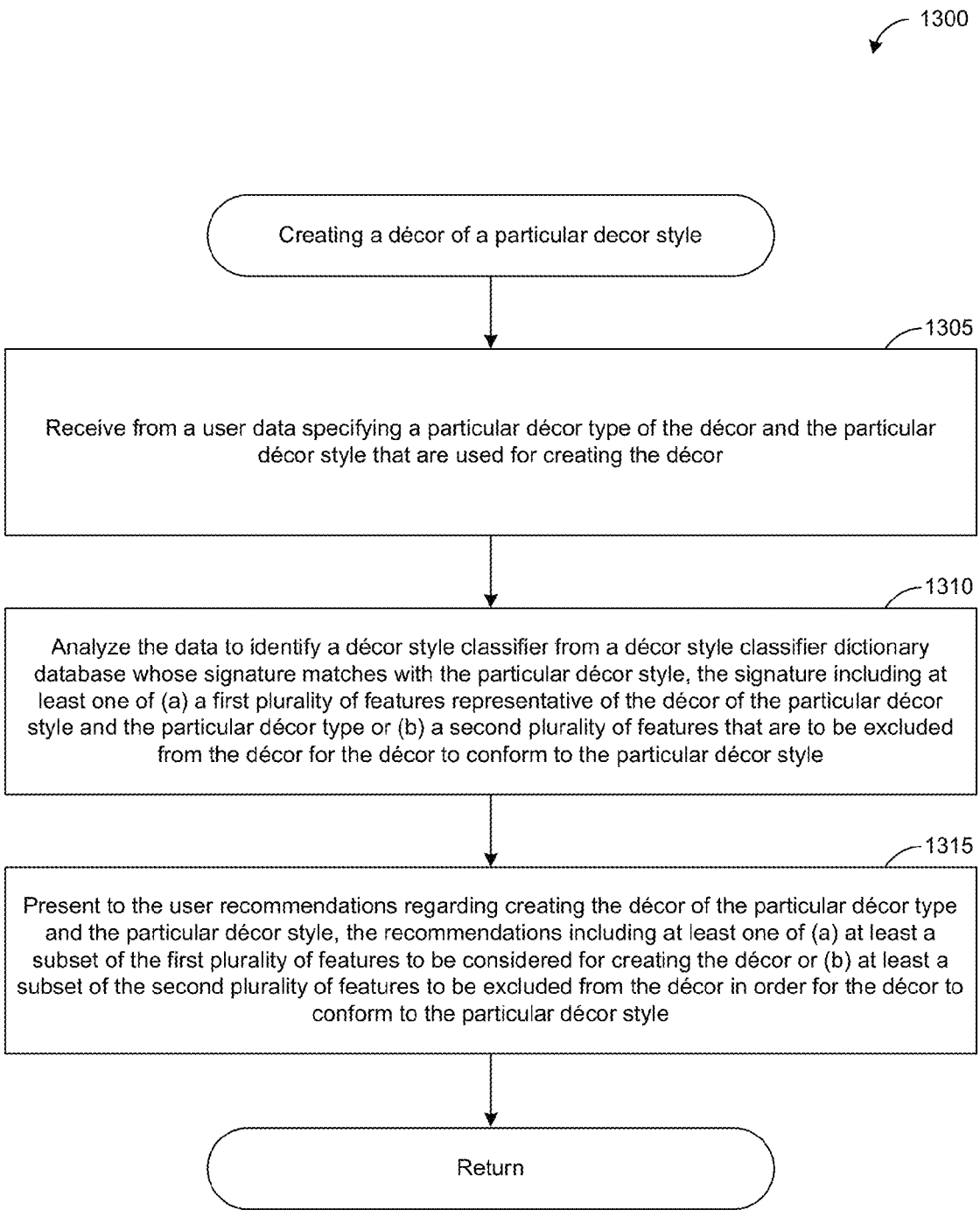
1300
Creating a décor of a particular decor style
1305
Receive from a user data specifying a particular décor type of the décor and the particular décor style that are used for creating the décor
1310
Analyze the data to identify a décor style classifier from a décor style classifier dictionary database whose signature matches with the particular décor style, the signature including at least one of (a) a first plurality of features representative of the décor of the particular décor style and the particular décor type or (b) a second plurality of features that are to be excluded from the décor for the décor to conform to the particular décor style
1315
Present to the user recommendations regarding creating the décor of the particular décor type and the particular décor style, the recommendations including at least one of (a) at least a subset of the first plurality of features to be considered for creating the décor or (b) at least a subset of the second plurality of features to be excluded from the décor in order for the décor to conform to the particular décor style
Return

FIG. 13

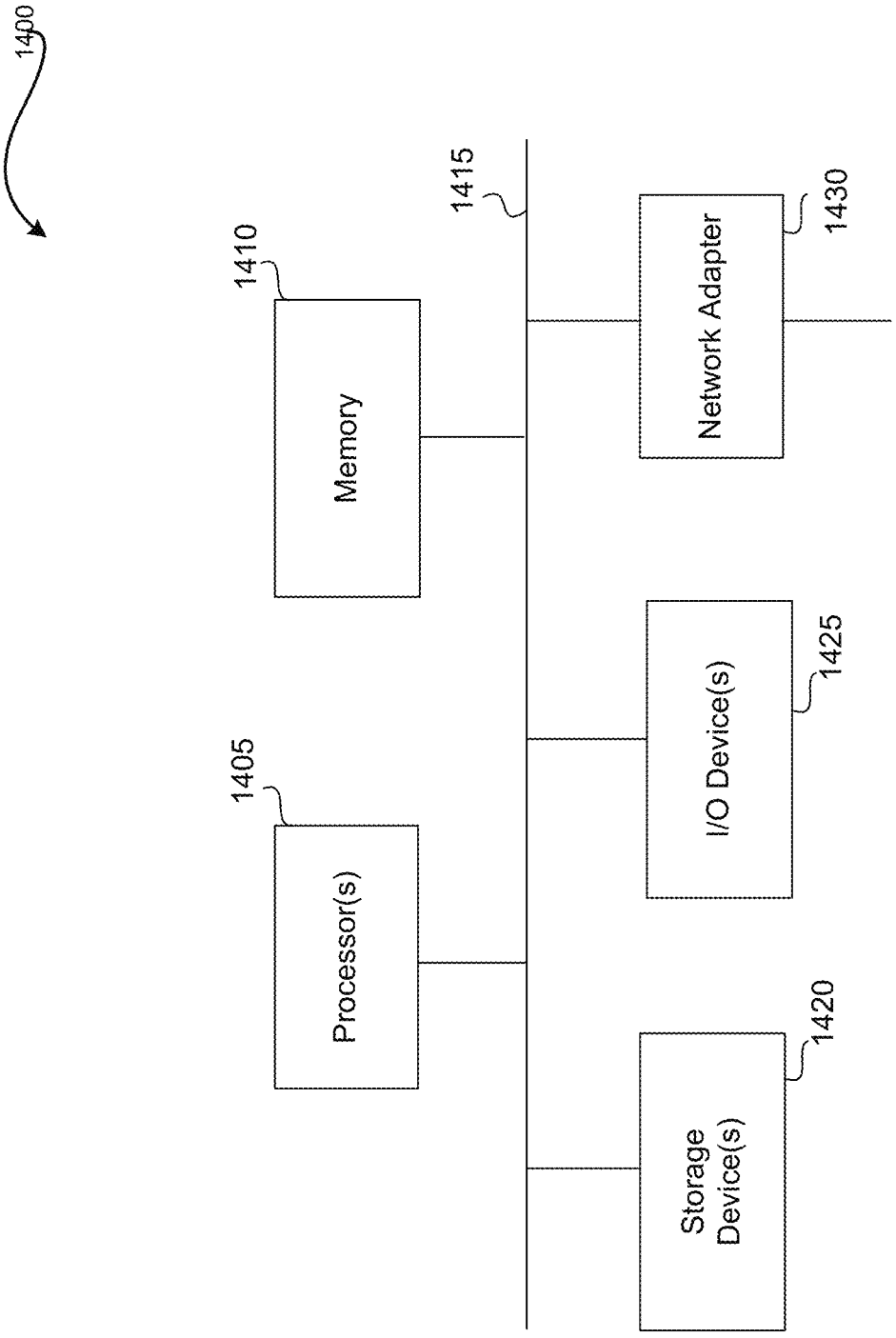
1400
1415
1410
Memory
Network Adapter
1430
I/O Device(s)
1425
1405
Processor(s)
Storage Device(s)
1420

FIG. 14

DISCOVERING AND PRESENTING DÉCOR HARMONIZED WITH A DÉCOR STYLE

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application claims the benefit of U.S. Provisional Application Ser. Nos. 61/809,802 titled "DIGITAL ART SYSTEMS AND METHODS" filed Apr. 8, 2013; 61/809,832 titled "DISCOVERING, VISUALIZING AND FACILITATING THE SELECTION OF ART, DESIGN, AND DECOR" filed Apr. 8, 2013; and 61/824,967 titled "DISCOVERING, VISUALIZING AND FACILITATING THE SELECTION OF ART, DESIGN, AND DECOR" filed May 17, 2013, all of which are incorporated herein by reference for all purposes in their entirety.

TECHNICAL FIELD

The disclosure relates to online tools for discovering décor, and more specifically to discovering and presenting décor that is harmonized with a décor style.

BACKGROUND

Current tools for finding décor items such as art, rugs, decorating paint, furnishings, fashion etc. are typically naïve. They do not address the problem of finding different décor items that match or harmonize to a particular required style. The current tools lack abilities to select décor items with visually common features, such as color or style. The current tools lack abilities to search across the Web for décor items based on décor attributes, such as color, the mood of a person, etc. Further, the décor styles are expressed by various users in various ways. For example, there are number of colors called "Green," the style "minimal" may mean differently to different users. The current tools typically lack abilities to coordinate these different ways of expressing a décor style to find harmonized décor items.

SUMMARY

Technology is disclosed for discovering décor that is harmonized with a décor style ("the technology"). The décor can include one or more of a variety of décor items such as artworks, paintings, pictures, artifacts, architectural pieces, arrangement of artworks, color selection, décor of a room, rugs, mats, furnishings, clothes, jewelry, fashion, car interiors, flower arrangements, gardens, etc. In various embodiments, the décor styles are defined based on a number of concepts including a theme of the décor such as "minimal," "abstract," "calm"; a mood of the person such as "happy," "party," "romantic"; a type of architecture such as "traditional" "contemporary," "Victorian"; color themes such as "Moroccan," "Greece" etc.

The technology facilitates analyzing a user input to determine a décor style specified by the user, identifying a décor style classifier from a system generated décor style classifier dictionary containing a number of décor styles that can be used by a décor discovery system for discovering décor, determining various décor based on the décor style classifier, and presenting a representation of the determined décor to the user using a variety of presentation techniques.

A particular décor style is characterized by style data which can include keywords or phrases that are indicative or descriptive of the particular style; sample images of the décor that match the particular style; and features of the décor items that are indicative of the particular style, which can include features such as a number of décor items in the room, placement of the décor items, color pattern of the room, color of the décor items, design of the décor items (e.g. form, shape, materials) etc. In various embodiments such features of the décor style can be gathered using morphological analysis techniques on an image representative of a décor of the particular décor style. One method of generating such style data is by crawling the World Wide Web and obtaining the data from websites, blogs, articles etc. discussing interior decoration, art, décor, etc. The style data can also be obtained from a number of other sources such as online magazines, documents that discuss fashion, interior decoration, art, décor, preferences and tastes of various users etc.

In some embodiments, the style data for a particular décor style may be defined by the user. The user can be an end user who consumes or is seeking recommendations regarding décor items, an expert (in décor) such as an architect, an interior designer, a photo stylist, or a clothing designer. The décor discovery system can also track trends in taste and décor style by tracking data associated with influential sources (e.g. fashion designers) in the décor industry. The décor discovery system creates, manages and updates the décor style dictionary with the style data obtained using the above methods.

In various embodiments, the décor discovery system tracks user preferences for a particular décor style based on the various décor items chosen by the user and uses the style data associated with user preference to update the décor style dictionary as necessary.

In various embodiments, the décor discovery system facilitates automatic generation of color palettes based on a number of décor styles such as a mood of a person, travel theme, fashion era etc. The suggested color palettes may be then used, for example, in creation of art, selection of art that matches with the décor of a room, selection of a new décor for the room, etc.

In various embodiments, the décor discovery system may discover décor based on a décor style data input by the user. The user may specify the required décor style in the form of keywords and/or images. The keywords can be indicative of style names, features or attributes, color pattern etc. of the décor items. The image can be of one or more of décor items. For example, the user may upload a picture of an existing room to the décor discovery system and discover décor, e.g. decor items that are harmonized with the décor of the room.

In various embodiments, the décor discovery system facilitates presentation of the discovered décor using various presentation techniques such as three dimensional (3D) computer generated imagery (CGI) modeling. The user may view the discovered décor, for example, décor of a room or arrangement of a garden generated using 3D CGI techniques.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating an environment in which the technology can operate in various embodiments.

FIG. **2** is a block diagram illustrating a system to create a dictionary of décor styles, consistent with various embodiments.

FIG. **3** is an example implementation of a décor style dictionary, consistent with various embodiments.

FIG. **4** is an example of images of various décor styles, consistent with various embodiments.

FIG. **5** is an example of a tool for generating a color palette based on décor style, consistent with various embodiments.

FIG. **6** is a block diagram of a process for discovering décor based on décor styles, consistent with various embodiments.

FIG. **7** is an example of presentation of an artwork in a room using three dimensional (3D) computer generated imagery (CGI) modeling, consistent with various embodiments.

FIG. **8** is an example of art descriptor presented with an artwork, consistent with various embodiments.

FIGS. **9**A, **9**B and **9**C are collectively an example of arrangement of artworks based on décor styles, consistent with various embodiments.

FIG. **10** is a flow diagram of a process for discovering décor based on décor styles, consistent with various embodiments.

FIG. **11** is a flow diagram of a process for creating a décor style dictionary, consistent with various embodiments.

FIG. **12** is a flow diagram of a process for associating décor styles to a décor style classifier, consistent with various embodiments.

FIG. **13** is a flow diagram of a process for creating a décor of a particular décor style, consistent with various embodiments.

FIG. **14** is a block diagram illustrating components of an apparatus that may perform various operations described by the technology.

DETAILED DESCRIPTION

Technology is disclosed for discovering décor that is harmonized with a décor style ("the technology"). The décor can include one or more of a variety of décor items such as artworks, paintings, pictures, artifacts, architectural pieces, audio (e.g. music), arrangement of artworks, color selection, décor of a room, rugs, mats, furnishings, clothes, jewelry, fashion, car interiors, flower arrangements, gardens, etc. In various embodiments, the décor styles are defined based on a number of concepts including a theme of the décor such as "minimal," "abstract," "calm"; a mood of the person such as "happy," "party," "romantic"; a type of architecture such as "traditional" "contemporary," "Victorian"; color themes such as "Moroccan," "Greece" etc.

The technology facilitates analyzing a user input to determine a décor style specified by the user, identifying a décor style classifier from a system generated décor style classifier dictionary containing a number of décor styles that can be used by a décor discovery system for discovering décor, determining various décor based on the décor style classifier, and presenting a representation of the determined décor to the user using a variety of presentation techniques.

A particular décor style is characterized by style data which can include keywords or phrases that are indicative or descriptive of the particular style; sample images of the décor that match the particular style; and features of the décor items that are indicative of the particular style, which can include features such as a number of décor items in the room, placement of the décor items, color pattern of the room, color of the décor items, design of the décor items (e.g. their form, shape, materials) etc. In various embodiments such features of the décor style can be gathered using morphological analysis techniques on an image representative of a décor of the particular décor style. One method of generating such style data is by crawling the World Wide Web and obtaining the data from websites, blogs, articles etc. discussing interior decoration, art, décor, etc. The style data can also be obtained from a number of other sources such as online magazines, documents that discuss fashion, interior decoration, art, décor, preferences and tastes of various users etc.

In some embodiments, the style data for a particular décor style may be defined by the user. The user can be an end user who consumes or is seeking recommendations regarding décor items, an expert (in décor) such as an architect, an interior designer, a photo stylist, or a jewelry designer. The décor discovery system can also track trends in taste and décor style by tracking data associated with influential sources in the décor industry. The décor discovery system creates, manages and updates the décor style dictionary with the style data obtained using the above methods.

In various embodiments, the décor discovery system tracks user preferences for a particular décor style based on the various décor items chosen by the user and uses the style data associated with user preference to update the décor style dictionary as necessary.

In various embodiments, the décor discovery system facilitates automatic generation of color palettes based on a number of décor styles such as a mood of a person, travel theme, fashion era etc. The suggested color palettes may be then used, for example, in creation of art, selection of art that matches with the décor of a room, selection of a new décor for the room, etc.

In various embodiments, the décor discovery system may discover décor based on a décor style data input by the user. The user may specify the required décor style in the form of keywords and/or images. The keywords can be indicative of style names, features or attributes, color pattern etc. of the décor items. The image can be of one or more of décor items. For example, the user may upload a picture of an existing room to the décor discovery system and discover décor, e.g. décor items that are harmonized with the décor of the room.

In various embodiments, the décor discovery system facilitates presentation of the discovered décor using various presentation techniques such as three dimensional (3D) computer generated imagery (CGI) modeling. The user may view the discovered décor, for example, décor of a room or arrangement of a garden generated using 3D CGI techniques. The above mentioned embodiments and other embodiments of the technology are described below with reference to FIGS. **1-14**.

Environment for Décor Discovery

Turning now to FIG. **1**, FIG. **1** is a block diagram illustrating an environment **100** in which the technology can operate in various embodiments. The décor discovery system **105** facilitates a user **110** to discover décor, such as the décor items mentioned above, based on the style data **115** input by the user **110**. The décor discovery system **105** analyzes the style data **115** to determine a particular décor style classifier in a décor style dictionary (not illustrated) that defines a décor style corresponding to the style data **115**. The décor discovery system **105** retrieves images of a number of décor items **125** based on the particular décor style classifier and presents the images of décor items **125** to the user **110**. In some embodiments, the décor discovery system **105** can combine various décor items into one harmonized décor and present the harmonized décor to the user. For example, the décor discovery system **105** can determine various décor items of a room based on a particular décor style, combine the determined décor items to form a harmonized room décor, and present the harmonized room décor to the user.

In some embodiments, the user **110** may want to view décor items of the particular décor style having a certain combination of colors. The décor discovery system **105** generates a number of color palettes **120** based on the particular décor style classifier. The user **110** may choose one of the color palettes **120** and view only those décor items having color combinations similar to the chosen color palette **120**.

In various embodiments, the style data **115** input by the user can include data such as "minimal," "abstract," "calm," "Zen-like" indicating a theme of the décor; "happy," "party," "romantic" indicating a mood of the person; "traditional" "contemporary," "Victorian" indicating a type of architecture; "Moroccan," "Greece" indicating color themes etc. In various embodiments, the style data **115** can be input by the user **110** in the form of free text, an image depicting a particular décor style, a user selection of predefined styles, or a combination of the foregoing.

In various embodiments, the accuracy of recommendation of various décor items by the décor discovery system **105** depends on a definition a particular décor style classifier to include an extensive set of features the users may associate with a décor style represented by the particular décor style classifier, and a proper identification of a particular décor style classifier from the décor style dictionary based on the user input. The creation of décor style classifiers and the décor style dictionary are described in further detail with reference to at least FIGS. **2-5**.

Décor Style Dictionary

Turning now to FIG. **2**, FIG. **2** is a block diagram illustrating a system **200** to create a dictionary of décor styles, consistent with various embodiments. In various embodiments, the system **200** may be implemented in the environment **100** of FIG. **1**. The system **200** can be used to define various décor styles and organize them as corresponding décor style classifiers in a décor style dictionary **225**. The décor style dictionary **225** may be stored in computer readable medium according to any suitable storage mechanism such as well known database storage techniques. An example implementation of a décor style dictionary created using system **200** is illustrated in FIG. **3**.

The example implementation **300** of the décor style dictionary includes décor style classifiers such as "Romantic Style," "Zen-like Style," "Abstract." Each of these décor style classifiers describe a particular décor style. The factors that can contribute to defining, identifying, or describing the particular décor style is included in the signature of the particular décor style classifier. For example, when a user says he/she wants the décor of the room to be "romantic," he/she may mean that room has to have vases with red roses, a love seat, a light colored wall, a number of paintings with subject as romance or love. Similarly, for another user "romantic" style may mean that the room has to have flower themed chandeliers, large areas of pink color, smooth satin sheets, cushions with heart designs on them, etc. Accordingly, the décor style classifier "Romantic Style" is defined using an extensive set of features that the users may associate the style with. As illustrated in the example implementation **300** of the décor style dictionary, the signature of décor style classifier "Romantic Style" can include (a) keywords such as "love", "darling," "honey" etc.; (b) décor features (representation of décor items) such as "heart," "kiss," "candle," "large portions of red," "loveseat"; (c) preferred colors such as "red", "pink" etc. and (d) location of images that correspond to the "Romantic Style" and other information associated with each of the images, such as colors in an image, features of the image, keywords indicative of the features of the image etc.

The other décor style classifiers "Zen-like Style" and "Abstract" may be defined similarly. Further, in various embodiments, the décor style classifiers may also include information regarding features that are not preferred by the users for a particular décor style. For example, some users may not consider a color such as bright green to be romantic. Some users may not want to have a television in a romantic style room. The information regarding non-preferred features may be included in the décor style classifiers in various ways. For example, the definition of décor style classifiers can have non-preferred data as "exclusions." In another example, each of the keywords or features of the definition may be associated with a weight that indicates a degree of match of a keyword or feature with a décor style corresponding to the particular décor style classifier. The décor discovery system **100** ensures that the décor items having excluded features or features that have a weight below a particular threshold are excluded from the recommendation. In various embodiments, the definition of the décor style classifiers may be updated continuously to reflect a change in user preferences.

In some embodiments, a color or color palette could be a separate décor style classifier. For example, the décor style classifier "Color_Vintage Style" can describe the colors that match with "vintage" style as perceived by the users.

Referring back to FIG. **2**, the system **200** includes a data gathering module **205** that gathers style data from various sources that can be used to define various décor style classifiers. The data gathering module **205** analyzes various sources to identify and extract any information that is relevant to or associated with décor. The information can include, for example, descriptions, discussions, or images associated with or relevant to décor such as artworks, paintings, pictures, artifacts, architectural pieces, arrangement of artworks, color selection, décor of a room, rugs, mats, furnishings, clothes etc. The information can further include descriptions, discussions, or images associated with or relevant to a style of décor, including a theme of the décor, a mood of the person, a type of architecture, color themes etc.

In various embodiments, the data gathering module **205** gathers the above style data in the form of (a) keywords or phrases describing or associated with the décor style, (b) features associated with the décor style, (c) images that correspond to various décor styles, (d) metadata of the images, and (e) location of the images. Examples of keywords describing theme based décor style can include "minimal," "abstract," "calm," "color trends for 2013"; mood based décor style can include "happy," "party," "romantic"; architecture type based décor style can include "traditional," "contemporary," "Victorian"; culture based décor style can include "Moroccan," "Greece," "Middle Eastern" etc. Examples of features gathered include color patterns of a décor style, features of objects in the décor, arrangement of objects in the décor etc. In various embodiments, the data gathering module **205** can use image analysis techniques such as morphological analysis to gather features from the images of various décor items.

The sources from which the data gathering module **205** obtains the above information can include websites, blogs, journals, documents, magazines that are relevant to décor. In some embodiments, a user too can provide information regarding décor style to the data gathering module **205**.

The style analysis module **210** analyzes the information extracted by the data gathering module **205** to identify different décor styles, and associate the keywords, phrases, features, images with their corresponding décor styles. For example, from the information extracted, the style analysis module **210** may recognize "romantic" as one of the styles. The style analysis module **210** analyzes the extracted information to identify the keywords, phrases, features, images with "romantic" décor style. The style analysis module **210** may identify keywords or phrases such as "roses," "love," "love is in the air," "honey," "darling," etc. associated with the "romantic" décor style. The style analysis module **210** may identify features such as vases with red roses, a love seat, a light colored wall, a number of paintings with subject as

romance or love, flower themed chandeliers, large areas of pink color, smooth satin sheets, and cushions with heart designs on them from the sampled images as associated with "romantic" style. The style analysis module **210** may also analyze metadata associated with sampled images to obtain any information, including keywords indicative of the features of the image, that may be used to identify the particular décor style.

Further, in various embodiments, the style analysis module **210** may also combine two similar décor styles into one décor style before passing the analyzed information to the style dictionary creation module **215**. For example, the style analysis module **210** may combine a particular décor style referred to as "love" style by some of the sources with a particular décor style referred to as "passion" or "fantasy" styles by another source into one combined style "romance." In various embodiments, the keywords, features and images corresponding to the separate décor styles are also combined into the "romance" style. In some embodiments, the style analysis module **210** may decide to combine various styles into one based on a meaning of keywords of the décor styles being semantically same.

The style dictionary creation module **215** obtains the analyzed information, including décor style and associated keywords, features and images, from the style analysis module **210**, and creates a décor style classifier representing the décor style in the décor style dictionary **225**. An example of the décor style classifier created by the style dictionary creation module **215** can include a décor style classifier such as the "Romantic Style" illustrated in example implementation **300**. After creating the décor style classifier, the style dictionary creation module **215** may also store the location of the images corresponding to the décor style in association with the décor style classifier, as illustrated in the example implementation **300**. In various embodiments, the décor style classifier can include, for each of the images associated with the decor style classifier, various details of the image such as colors in the image, keywords associated with image, features of the image etc. This information may be useful for creating a variety of indices for the images that enables fast retrieval based on various search criteria.

In various embodiments, the style dictionary creation module **215** can also identify other keywords, features and images that can be associated with a particular decor style classifier. One example of such an identification method can include identifying keywords that are semantically same as the keywords associated the particular décor style classifier. The style dictionary creation module **215** can identify such keywords from the set of keywords associated with other décor style classifiers in the décor style dictionary **225** or can obtain the keywords from a number of other sources such as Internet, English dictionaries, décor magazines etc.

In various embodiments, the décor style dictionary **225** serves as a lookup service for identifying a particular décor style classifier based on the user input of décor style. The particular décor style classifier is then used for generating décor recommendations. The style dictionary creation module **215** implements the décor style dictionary **225** using a suitable data structure. In various embodiments, the data structure may be implemented such that it supports fast and efficient searching and retrieval of the décor style classifiers based on the user input. In various embodiments, the style dictionary creation module **215** may index and/or cluster the keywords, features, images based on the décor styles they are associated with.

The system **200** includes a recommendation engine **220** that is used to facilitate recommendation of décor items to the user. The recommendation engine **220** can be used in various ways. For example, the recommendation engine **220** can be used to search various décor items from various sources and analyze them to determine whether they match with the style data **115** input by the user. The recommendation engine **220** may also be used to analyze the user input, including style data **115**, to identify a particular décor style classifier from the décor style dictionary. Further, the recommendation engine **220** may also be used to improve the accuracy of definitions of the decor style classifiers in the décor style dictionary **225**. In various embodiments, the recommendation engine **220** can be implemented using a rule-based expert system (hereinafter simply "expert system"), a clustering engine, or various other self-learning techniques that can classify, group, categorize or associate different data based on a certain criteria. In the context of the disclosed technology, the recommendation engine **220** can be used to classify, group, categorize or associate images and keywords representing various décors of various décor styles into specific décor styles.

Consider an example where the recommendation engine **220** is implemented as an expert system. The expert system can include an inference engine (not illustrated) that facilitates in making decisions on recommendation of décor items based on the rules (e.g. décor style definition) defined in a knowledge base (not illustrated). At work, the inference engine reasons about the knowledge base like a human. In various embodiments, the décor style dictionary **225** may form the knowledge base of the expert system. Further, the definitions of the décor style classifiers may be expressed as rules. In various embodiments, the rules are expressed with natural language such as "IF . . . THEN . . . . " However, the rules may be formulated in various other ways and may be adapted to a particular inference engine style.

Every rule has an IF part, also called the antecedent and a THEN part, also called the consequent part. These rules must link the evidence about the problem under consideration to the conclusion. For example:

"IF it is love THEN it is romance"

"IF style=romance THEN color in décor item≠bright green"

"IF the number of décor items in the image is not known with certainty AND the color pattern includes large portions of pink AND the morphological features indicate décor items with heart design AND the sheets on the bed is satin and red THEN there is a strong probability (0.8) that the style is of type Romance"

The inference engine is designed to produce reasoning on rules. In order to produce reasoning, it should be based on logic. There are several kinds of logic, including propositional logic, predicates of order 1 or more, epistemic logic, modal logic, temporal logic, fuzzy logic, probabilistic logic, etc. Propositional logic is the basic human logic that is expressed in syllogisms. With logic, the inference engine is able to generate new information from the knowledge contained in the knowledge base and data to be processed. That is, in the example where the expert system is used to facilitate recommendation of décor items, the expert system will be able analyze various décor items (e.g. images and/or keywords representing the décor items) and classify them, as per the rules, into appropriate décor styles based on the features and/or keywords associated with the décor items. The expert system can then make improved, informed and more accurate recommendations of decor items.

Referring back to the recommendation engine **220**, consider an example where it is implemented as a clustering engine. The clustering engine can analyze various décor items (e.g. images and/or keywords representing the décor

items) and create a number of clusters based on the features and/or keywords associated with the décor items such that images having similar features or keywords indicative of similar décor style are grouped into a cluster. The cluster represents a particular décor style. In some embodiments, separate clusters may be formed for features and keywords. Each of the clusters can then be associated with a particular décor style classifier. Such clustering techniques can be used to classify décor items into appropriate décor styles based on the features and/or keywords associated with the décor items and then, make improved, informed and more accurate recommendations of decor items.

Further, in various embodiments, the recommendation engine **220** can track the user input including style data **115**, a list of décors **115** recommended by the décor discovery system **105** and the décors chosen or not chosen by the users for the particular style data **115**. Accordingly, the recommendation engine **220** may track the user preferences and determine whether a definition of the décor style classifier can be improved to better match with user's perception of the décor style it represents. The recommendation engine **220** may suggest the style creation dictionary module **215** to update the definition of the particular décor style classifier accordingly. For example, the recommendation engine **220** may suggest updating the definition of a décor style classifier by adding, modifying or removing keywords, features or images associated with it. Alternatively or additionally, a user such as an expert in the décor field may manually train (e.g. add, modify or delete the rules) the recommendation engine **220** to improve the accuracy.

In various embodiments, the recommendation engine **220** may also be designed to assign a weight (also referred to as a "style probability") to the keywords, features or images associated with a décor style classifier. The weight indicates a degree of a match between the keywords, features or images and the corresponding décor style classifier. The recommendation engine **220** may adjust (e.g. increase or decrease) the weight of the keywords, features or images corresponding to the décor style classifier based on the user selection of decors of the décor style to which the décor style classifier corresponds. For example, if a user selects a particular décor from a plurality of decors of a décor style to which the décor style classifier corresponds, the expert system may increase the weight of the keywords and/or features related to the particular décor in the signature of the décor style classifier. The increase in weight indicates an increase in the degree of match between the keywords and/or features and the décor style to which the décor style classifier corresponds.

FIG. **4** is an example **400** of images of various décor styles, consistent with various embodiments. An image **405** can be artwork such as a picture or a painting. An image **410** can be a picture of a décor of a room. In various embodiments, the image can be of other décor items such as a product in a catalogue—e.g. sofa, necklace or hat. In the example **400**, the images **405** and **410** are considered to be of different styles by different users. For example, while a first user may consider the images **405** and **410** to be of "Minimal" and "Eclectic" décor styles, respectively, a second user may consider them to be of "Clean" and "Busy" décor styles, respectively, and a third user may consider them to be of "Architectural" and "Organic" décor styles, respectively.

A system such as system **200** can analyze the images **405** and **410** and associate them with particular décor style classifiers. In some embodiments, the system **200** may analyze the keywords describing the décor styles, features of the images, the color pattern in the images, décor items in the images etc. to determine the décor style classifier they have to be associated with. In one example, the system **200** may determine to associate the image **405** with a décor style classifier, for example, a "Zen-like" décor style as illustrated in décor style dictionary **300**, that has keywords semantically similar to that of "Minimal," "Clean" and "Architectural". The system **200** may also associate the foregoing keywords with the décor style classifier "Zen-like". Additionally or alternatively, the system **200** may associate the image **405** with another décor style classifier that has features (e.g. morphological features), color pattern etc. similar to that of the image **405**. For example, if an image has areas that lack "patterns" and are linear-edged, uniformly shaped, symmetrical (etc.), then the image might be classified as "Minimal" if such a morphology is often seen in décor of "Minimal" style décor.

In some embodiments, the system **200** may associate the image **405** with a style probability indicating a probability of the image **405** being of a particular décor style. The system **200** analyzes and associate the image **410** with one or more décor style classifiers similarly. Further, in some embodiments, the system **200** also assigns weight to the keywords and features of the images **405** and **410** indicating a degree of match of the keywords or features to the décor style represented by the décor style classifier.

FIG. **5** is an example of a tool **500** for generating a color palette based on décor style, consistent with various embodiments. The tool **500** can be used to generate a color palette **510** based on décor style **505** input by the user. The user can choose a palette from the color palette **510** and then proceed to searching for décor that corresponds with the chosen color palette and the décor style **505**.

In various embodiments, the tool **500** can be implemented in a system such as system **200** of FIG. **2**. The user can input various types of décor style such as décor concept, theme of the décor, mood of a person etc. The décor style **505** input by the user includes a mood of a person such as "Whimsical." The tool **500** also displays a description **515** of the mood "Whimsical." In some embodiments, the description **515** may help the user to get an understanding of what the tool **500** may interpret the mood as. Upon receiving the décor style **505** input from the user, the tool **500** identifies a décor style classifier from the décor style dictionary corresponding to the décor style **505**. The tool **500** then identifies a set of colors associated with the particular décor style classifier and generates a color palette **510** with various combinations of colors from the set of colors. Further, in some embodiments, the tool **500** may arrive at particular combinations of colors in each color palette **510** based on a weight associated with each of the set of colors.

In some embodiments, the tool **500** identifies a set of colors harmonized with a one or more colors input by the user. Given a color preference (e.g. a "key color") by the user, the tool **500** can generate harmonized colors according to various algorithms (e.g. related to color theory). In some embodiments, the set of harmonized colors may not be among the colors associated with the décor style classifier in the décor style classifier dictionary. If the set of harmonized colors are not yet associated with the décor style classifier in the décor style classifier dictionary, they will be associated with the décor style classifier.

FIG. **5** illustrates the décor style **505** being input as a selection of the décor styles from a drop down list having predefined values for décor styles. However, it should be noted that the user may input décor styles in various other ways, including free text. In some embodiments, the "key" color input by the user can be a selection of a color from a predefined list of colors presented by the tool **500** or could be

described by the user using product color names (e.g. from paint companies, furniture manufacturers etc.) figurative descriptions (e.g. pale yellow, sunset orange) or any type of descriptions in common use (e.g. as found on the Internet). The system **200** contains a dictionary of color names matched to various instances of color found in various sources such as product catalogues and descriptions. Given an input description for a color, the system **200** can find the nearest or closest color name belonging to a product.

In some embodiments, the user can also input a color using visual means, such as a photograph or a camera. The system **200** can determine a particular color by applying various known techniques, e.g. probabilistic logic, to guess the color name given the content of the image (e.g. if the system **200** analyzes that image is a sofa from IKEA, then it can identify the color ranges accordingly). In various embodiments, such techniques can be used to overcome the often significant limitations of smartphone cameras (e.g. color distortion).

FIG. **6** is a block diagram of a system for discovering décor based on décor styles, consistent with various embodiments. The system **600** can be implemented in an environment such as environment **100** of FIG. **1**. The system **600** includes a décor request receiving module **610** that receives a request to search for various décor of a particular décor style specified by a user **605**. In various embodiments, the user input of the décor style could be in the form of free text, a user selection of images from a list of images representing various decors of certain décor styles presented to the user **605** by the system **600**, a user selection of predefined décor styles, user input of images of décor. In some embodiments, the free text can include visual features of décor, like "zigzag" or "striped." Further, the user input can also include data specifying a type of décor. The type of decor can include one or more of a décor of a room, including furniture in the room, a color pattern of the room, clothes, artworks, household items etc.

The expert system **615** determines a number of decors that match with the particular décor style input by the user **605**. In various embodiments, the expert system **615** is similar to the recommendation engine **220** of FIG. **2**. In FIG. **6**, although the recommendation engine is implemented using an expert system **615** other implementations of recommendation engine as described in reference with FIG. **2** are possible. The expert system **615** analyzes the user input and identifies a décor style classifier from the décor style classifier dictionary database **620** that corresponds to the particular décor style specified by the user **605**.

In various embodiments, the expert system **615** determines a décor style classifier having a signature with features or keywords that match with the keywords or features of the images of the user input indicative of the particular décor style. After identifying the décor style classifier, the expert system **615** can obtain the locations of the images representing the decors corresponding to the décor style to which the décor style classifier corresponds from an index in the decor style classifier dictionary database **620** and provide them to the décor retrieving module **625**. The décor retrieving module **625** retrieves the images from the corresponding locations and provides them to the presenting module **645** for presentation to the user **605**.

In various embodiments, the expert system **615** can also obtain additional images of decors from a number of sources **635**. The sources **635** can be accessed over a communication network **630**, such as Internet, local area network (LAN), wide area network (WAN) etc. The sources **635** may or may not be similar to the sources from which the data gathering module **205** obtains the images of décor or the sources the locations of which is indexed in the décor style classifier dictionary database **620**. The expert system **615** can instruct the decor retrieving module **625** to obtain images representing various decors of various décor styles from the sources **635**. The style analysis module **640** extracts (a) the features and (b) keywords indicative of the features from the additional images and transmits them to the expert system **615** for further analysis. In various embodiments, the expert system **615** compares the keywords and the features of the additional images with the keywords and features of the décor style classifier corresponding to the particular décor style specified by the user **605** to determine whether the additional images are harmonized with the particular décor style.

In various embodiments, the expert system **615** can also determine whether an additional image is harmonized with the particular décor style to which the décor style classifier corresponds based on a function of the weight of the keywords or the features in the signature of the décor style classifier. For example, if the weight of the keywords or the features of décor style classifier that matched with the keywords or the features of an additional image is above a predefined threshold, then the expert system **615** may determine that the additional image is harmonized with the particular décor style. On the other hand, if the weight is below the threshold, the expert system **615** may determine that the additional image is not of the particular décor style.

Using a threshold for comparing the weight is just one example of a function of weight. In various embodiments, the expert system **615** can use various other functions of weight. For example, the expert system **615** can use a function that determines an average of the weights of all the keywords and features of the décor style classifier that match with the keywords or the features of an additional image. If the average weight exceeds a predefined threshold, then the additional image is considered to be harmonized with the particular décor style. In some embodiments, the average weight of the keywords and features of more than one décor style classifier that match with the keywords or the features of the additional image may exceed the predefined threshold. In such a case the additional image may be considered to be harmonized with more than one décor style.

The presentation module **645** presents the images of decors to the user **605**. In various embodiments, the presentation module **645** can present the images of the décors using a three dimensional (3D) computer generated imagery (CGI) modeling. In various embodiments, the 3D CGI modeling generates photo realistic imagery of the décor. For example, a 3D CGI modeling of a décor such as a décor of a room generates a photo realistic imagery of the room containing various décor items. In various embodiments, the user **605** can further customize the décor of the room by adding, modifying or removing décor items from the room, and view the 3D CGI of the customized decor. Further, the user may dynamically customize the décor in the 3D CGI of the room. For example, the user **605** may change the color of a portion or the whole room, move an artwork from one position to another, or remove a couch from the room, change the geometrical data such as size of the wall that affects the overall configuration of the room, and simultaneously view the 3D CGI of the customized décor of the room.

FIG. **7** is an example **700** of a presentation of an artwork **705** in a room using 3D CGI modeling, consistent with various embodiments. The artwork **705** can be viewed in 3D CGI of such various rooms.

Referring back to FIG. **6**, in various embodiments, the system **600** can discover various décor items that are harmonized with a décor style of a specific room input by the user **605**. In various embodiments, the user **605** may upload a two

dimensional (2D) image of the specific room. For example, the user **605** may include as user input to the décor request receiving module **610** an image of the décor of a room the user **605** intends to find the décor items for. The expert system **615** determines the features of the room, e.g. using on morphological analysis, finds the décor items (e.g. as explained above) and presents the décor items to the presentation module **645**. The presentation module **645** can generate a 3D CGI of the room input by the user **605** with décor items discovered by the expert system **615**.

In various embodiments, the system **600** can also generate descriptions such as a reason why a particular décor was chosen by the system **600**. For example, an artwork can be presented with an art descriptor that includes a brief description of the artwork and/or a reason why the artwork is selected. In various embodiments, the art descriptor may help the user understand why a particular artwork was recommended.

Consider a scenario where the user **605** intends to obtain décor, such as artworks, based on a specific user-input color palette. The expert system **615** can find and present artworks that includes one or more colors in addition to or instead of the colors specified in the user-input color palette. In various embodiments, the expert system **615** may select such artworks because it may consider that the one or more colors harmonizes well with the specific user-input color palette. The presentation module **645** presents the art descriptor in association with the artworks. FIG. **8** is an example **800** of presenting an art descriptor **810** in association with an artwork **805**, consistent with various embodiments. The art descriptor **810** can include a brief description such as a name of the artwork and artist. The art descriptor **810** can also include a reason for selection of the artwork **805**, such as "Red Daisy Flower was curated for you because it contains a rich expression of Candy Floss, a faint wisp of Fandango and a delicate dash of Cappuccino." The art descriptor **810** can also include a reason for why the artwork **805** with the colors "Candy Floss," "Fandango" and "Cappuccino" was selected even though the user did not include those colors in the specific user-input color palette (not illustrated). The reason can be, for example, "These colors are congruent with your love of Get Reddy, Harlequin and Brandy" as illustrated in art descriptor **810**.

In various embodiments, the presentation module **645** can also highlight the text indicative of the colors in the art descriptor **810**. For example, a font or a background of a text indicative of a particular color may be presented in the particular color. In the example **800**, the art descriptor **810** presents a text indicative of a particular color, e.g. "Candy Floss" with the "Candy Floss" color background. In various embodiments, the presentation module **645** can also present a color palette **815** of the artwork **805** in association with the artwork **805**.

Referring back to FIG. **6**, the system **600** can also generate recommendations regarding various possible arrangements of décor items in a décor. For example, the system **600** can generate recommendations regarding various arrangements of décor such as artworks based on one or more of features such as a color palette of the artworks, a frame type of the artworks, features of the artworks, a finish type, e.g. matte, glossy, etc. of the artworks, a genre, an artist, content of the artworks.

In various embodiments, the system **600** can also determine a text, that is a description e.g. magazines, online articles etc., representing the plurality of decors harmonized based on the décor style classifier. In some embodiments, the system **600** can also determine applications (e.g. online applications) for creating a plurality of decors harmonized based on the décor style classifier.

FIGS. **9**A, **9**B and **9**C collectively is an example of various arrangements of a set of artworks, consistent with various embodiments. The various arrangements of the artworks are generated using a system such as system **600** of FIG. **6**. The example arrangements **900**, **950** and **975** of FIGS. **9**A, **9**B and **9**C, respectively, illustrate arrangements of six artworks based on different criteria. The example of FIG. **9**A, illustrates an arrangement **900** of six pieces of "abstract" style artwork with a color palette of green, blue and red predominantly distributed among the artworks. In various embodiments, one of the reasons for recommending various arrangements is to create an arrangement that is sophisticated or pleasing to the eye and in congruence with the décor style. The arrangement **900** is one such arrangement where the artworks are arranged in a specific way based on the color palette of the artworks. In the arrangement **900**, in the first row, the artworks with predominantly green palette are alternated with a predominantly blue palette artwork, and in a second row, the artworks with predominantly blue palette are alternated with a predominantly red palette artwork. In various embodiments, the artworks may be arranged in various other patterns. Additionally or alternatively, the arrangement can also be based on a color pattern in the artwork, that is, a pattern of one or more colors in the artwork. Further, in various embodiments, the expert system **615** may provide improved recommendations of arrangements based on a user selection/input/feedback on prior recommendations.

The example of FIG. **9**B illustrates an arrangement **950** of six pieces of artwork having a color palette distributed among green, blue and red. In the example of FIG. **9**B, each of the artworks have an equal distribution of at least two colors. Further, a primary color, e.g. green, is in a top portion of all the artworks and secondary and tertiary colors, blue and red, are in bottom portions of three pieces of artworks each. The arrangement **950** includes, in the first row, artworks with shades of green in the top portion and blue in the bottom portion and, in the second row, artworks with green in the top portion and red in the bottom portion. In various embodiments, the system **600** may also consider a color of the frame, a finish type of the artwork, etc. in recommending various arrangements. In general, the images can be arranged according to their color, size and style to obtain an arrangement that is congruent with the user's taste and/or the décor style of the room.

In the example FIG. **9**C, artworks are arranged based on features such as morphological features of the images. The example of FIG. **9**C includes a combination of artworks that are considered either predominantly busy, partly busy, or not busy. For example, the first and third artworks in the first row of arrangement **975** can be considered to be of predominantly "busy" style. Similarly, the first artwork in the second row is considered to be partly busy on the right portion of the artwork, and the third artwork is considered to be partly busy on the left portion of the artwork. The arrangement **975** places, in the first row, the predominantly busy artworks separated by a not busy blue color palette artwork. In the second row, the arrangement **975** places the partly busy artworks separated by a not busy red color palette artwork. The arrangement **975** has placed the partly busy artworks in a symmetrical fashion, e.g. symmetrical on either sides of the red artwork. Various other combinations are possible. For example, the second row may be arranged as the first row or the partly busy artworks may be placed such that the busy portions are facing away from one another instead of towards each other.

In various embodiments, the recommendation of arrangement combinations can also consider factors such as a layout of the arrangement, e.g. landscape, portrait, a circular arrangement etc.; a dimension of the available space where the artworks are intended to be installed; a shape of the frame of the artworks; existing decor items, e.g. vases or soft furnishings of a certain pattern, design and color etc., already in a room where the artworks are intended to be installed.

In various embodiments, similar recommendation, including what décor items to buy in what color, pattern and design to create a particular décor arrangement, such as vases, rugs, cushions and art, can be provided. For example, the striped pattern of cushions could be deployed as a motif for the wall décor, in unison, contra-unison etc. with a particular décor style.

In some embodiments, the system **600** can also recommend fashion accessories and/or clothes based on a particular décor style specified by the user. For example, the user may want a recommendation of clothing accessories based on a particular style of a celebrity such as "Michael Jackson." The system **600** discovers various décor items such as hats, ties, shoes, glove etc. that users typically associate with Michael Jackson, that are endorsed, worn, are similar to that worn by Michael Jackson, etc. In another example, the system **600** can also provide recommendations of fashion accessories based on a particular fashion designer, a particular color trend. In some embodiments, the system **600** can also recommend fashion accessories that match, complement, supplement, or contrast with a particular accessory input by the user (as an image and/or keywords describing the particular accessory) based on one or more of color, design pattern, size, designer of the particular color accessory etc.

Referring back to FIG. **6**, in various embodiments, the system **600** can also present recommendations regarding service providers who can facilitate creating the decors discovered by the system **600** and/or merchants where the decors are available for purchase. The service providers or the merchants can include clothing designers, jewelers, interior decorators, architects, décor experts, websites that include information on décor styles, online applications that can help create décor based on the décor styles etc. In various embodiments, the service providers or the merchants can have affiliation with a provider of system **600** to facilitate selling of their services or products associated with décor.

FIG. **10** is a flow diagram of a process for discovering décor based on décor styles, consistent with various embodiments. In various embodiments, the process **1000** may be executed in a system such as system **600** of FIG. **6**. At step **1005**, the décor request receiving module **610** receives a request to search for images of décor based on a particular décor style input by a user. In various embodiments, the user input of décor style could be in the form of free text, user selection of images, user selection of predefined décor styles, including tastes of well-known designers etc. For example, the user may want to decorate their room according to the style and tastes of an expert (or a celebrity) whose style and taste can be analyzed using the methods already described above. In various embodiments, the styles of users such as experts, celebrities can be created as separate décor styles using the methods described above or the décor styles in the décor style classifier dictionary that match with the styles of the users or celebrities can be tagged with certain stylists, designers etc.

At step **1010**, the expert system **615** analyzes the user input and performs a lookup in a décor style classifier dictionary database **620** to identify a décor style classifier that corresponds to the décor style input by the user. The décor style classifier dictionary **620** includes a number of décor style classifiers that correspond to various décor styles. In various embodiments, the analysis of the user input can include comparing the keywords and/or features of images of the user input with the keywords and/or features in the décor style classifier dictionary to identify a matching décor style classifier. If the expert system **615** does not find a match, it may present a few keywords from the décor style classifier dictionary that is probably relevant to or is semantically similar to the keywords of the user input to the user. The user may then select one or more of the presented keywords.

At step **1015**, the expert system **615** identifies the décor style classifier based on the analysis of step **1010**. At step **1020**, the expert system **615** determines whether the décor request receiving module **610** indicated that a user wants to choose a color palette. At step **1025**, responsive to a determination that the user wants to choose a color palette, the expert system **615** generates a number of color palettes corresponding to the décor style classifier, e.g. based on the colors included in the signature of the décor style classifier for selection by the user. At step **1030**, the expert system **615** determines various decors that are harmonized with the user selected color palette and the décor style to which the décor style classifier corresponds. In an embodiment, the expert system **615** refers to the index of images, which is created based on the décor style classifiers, in the décor style classifier dictionary database **620** to obtain the location of images matching with the selected color palette and the décor style to which the décor style classifier corresponds. Then the expert system **615** can request the decor retrieving module **625** to obtain those images from the corresponding locations. At step **1040**, the presentation module **645** presents the images of the harmonized décor.

Referring back to step **1020**, if the expert system **615** determines that the user does not want to choose a color palette, at step **1035**, the expert system **615** determines various decors that are harmonized with the décor style to which the décor style classifier corresponds. At step **1040**, the presentation module **645** presents the images of the harmonized décor.

FIG. **11** is a flow diagram of a process for creating a décor style dictionary, consistent with various embodiments. In various embodiments, the process **1100** may be executed in a system such as system **200** of FIG. **2**. At step **1105**, the data gathering module **205**, obtains content such as a number of images and description indicative of various décor styles from a number of sources. At step **1110**, the style analysis module **210** determines a signature of a particular décor style which includes a number of features of an image and keywords indicative of the particular décor style. At step **1115**, the style dictionary creation module **215**, determines whether the décor style dictionary includes a décor style classifier corresponding to the particular décor style. If the décor style dictionary includes a décor style classifier corresponding to the particular décor style, at step **1120**, the style dictionary creation module **215** updates the décor style classifier to include the features and the keywords in addition to existing features and keywords associated with the décor style classifier.

On the other hand, if the décor style dictionary does not include a décor style classifier corresponding to the particular décor style, at step **1125** the style dictionary creation module **215** adds a new décor style classifier corresponding to the particular style to the décor style classifier dictionary and associates the signature of the particular décor style with the new décor style classifier.

FIG. **12** is a flow diagram of a process for associating décor styles to a décor style classifier, consistent with various embodiments. In various embodiments, the process **1200**

may be executed in a system such as system **200** of FIG. **2**. At step **1205**, the recommendation engine **220** (also referred as expert system **220**) determines a set of features and a set of keywords indicative of a particular décor style to be associated with a particular décor style classifier. In various embodiments, the expert system **220** is a rules-based expert system. The expert system **220** includes data regarding the décor style classifiers and a number of features and keywords associated with each of the décor style classifiers, as a number of rules.

At step **1210**, the expert system **220** associates a particular décor style classifier in the décor style classifier dictionary with the set of features and the set of keywords determined based on the rules. At step **1215**, the expert system **220** tracks style preference data of a number of users for a décor style to which a particular décor style classifier corresponds. At step **1220**, the expert system **220** updates the set of features and/or keywords associated with the particular décor style classifier based on the style preference data. Also, in various embodiments, the expert system **220** associates a weight with each of the set of features and keywords that indicates a degree of match of a particular feature or keyword with the particular décor style.

FIG. **13** is a flow diagram of a process for creating a décor of a particular décor style, consistent with various embodiments. In some embodiments, the process **1300** may be executed in association with a system such as system **600** of FIG. **6**. At step **1305**, the décor request receiving module **610** receives from a user data specifying a particular décor type and a particular décor style of the décor that the user is interested in creating. In some embodiments, the user can specify the data, including the particular décor style and type, using a set of keywords. For example, data specifying a particular décor type can include keywords "décor of a room," and the data specifying a particular décor style can include keywords "romantic." However, the user can input data in various other forms, including as a selection of predefined styles and/or décor types.

At step **1310**, the expert system **615** analyzes the data to identify a décor style classifier from a décor style classifier dictionary database whose signature matches with the particular décor style. As described with reference to at least FIGS. **2** and **3**, a signature of a décor style classifier can include a plurality of features representative of the décor of the particular décor style to which the décor style classifier corresponds. The signature can also include, e.g., as "exclusions," a plurality of features that are to be excluded from the décor in order for the décor to conform to the particular décor style.

At step **1315**, presentation module **645** obtains the recommendations from the expert system **615** and presents the recommendations for creating the décor of the particular décor style and décor type to the user based on the signature of the décor style classifier. In some embodiments, the recommendations can include features representative of the décor of the particular décor style and the particular décor type to which the décor style classifier corresponds. As described above, the features of décor can include one or more of (a) décor items in the décor, (b) a placement of the décor items, (c) color pattern of the décor, (d) color of the décor items, or (e) design of the décor items, e.g. shape, form, material, pattern etc. In some embodiments, such features may be determined using morphological analysis of one or more images representing a plurality of decors of the particular décor style and the particular décor type.

Referring back to step **1315**, in the example of creating a "décor of a room" with "romantic" style, the recommendations can include, "Consider including a bed in the shape of heart." It can also include "Consider having a white bed sheet made of silk or satin." It can also include "Consider having a number of candles by the bed." It can also include "Consider having a combination of artworks, including paintings, murals or sculptures depicting love." It can also include "Consider having vases with red roses." It can also include "Consider having vases that are of soft or light colors."

In some embodiments, the recommendations can also include a set of the features that the user can consider excluding from the décor in order for the décor to conform to the particular décor style. Continuing with the above example, the recommendation can include "Do not include a television set in the room." It can also include "Consider removing any bright or dark décor items." It can also include "Do not include any loud paintings."

Further, the recommendations can be presented as (a) images of décor created based on the recommendations and/or (b) a plurality of words describing each of the recommendations.

FIG. **14** is a block diagram of a computer system as may be used to implement features of some embodiments of the disclosed technology. The computing system **1400** may include one or more central processing units ("processors") **1405**, memory **1410**, input/output devices **1425** (e.g., keyboard and pointing devices, display devices), storage devices **1420** (e.g., disk drives), and network adapters **1430** (e.g., network interfaces) that are connected to an interconnect **1415**. The interconnect **1415** is illustrated as an abstraction that represents any one or more separate physical buses, point to point connections, or both connected by appropriate bridges, adapters, or controllers. The interconnect **1415**, therefore, may include, for example, a system bus, a Peripheral Component Interconnect (PCI) bus or PCI-Express bus, a HyperTransport or industry standard architecture (ISA) bus, a small computer system interface (SCSI) bus, a universal serial bus (USB), IIC (I2C) bus, or an Institute of Electrical and Electronics Engineers (IEEE) standard 1394 bus, also called "Firewire".

The memory **1410** and storage devices **1420** are computer-readable storage media that may store instructions that implement at least portions of the described technology. In addition, the data structures and message structures may be stored or transmitted via a data transmission medium, such as a signal on a communications link. Various communications links may be used, such as the Internet, a local area network, a wide area network, or a point-to-point dial-up connection. Thus, computer-readable media can include computer-readable storage media (e.g., "non-transitory" media) and computer-readable transmission media.

The instructions stored in memory **1410** can be implemented as software and/or firmware to program the processor(s) **1405** to carry out actions described above. In some embodiments, such software or firmware may be initially provided to the processing system **1400** by downloading it from a remote system through the computing system **1400** (e.g., via network adapter **1430**).

The technology introduced herein can be implemented by, for example, programmable circuitry (e.g., one or more microprocessors) programmed with software and/or firmware, or entirely in special-purpose hardwired (non-programmable) circuitry, or in a combination of such forms. Special-purpose hardwired circuitry may be in the form of, for example, one or more ASICs, PLDs, FPGAs, etc.

Remarks

The above description and drawings are illustrative and are not to be construed as limiting. Numerous specific details are

described to provide a thorough understanding of the disclosure. However, in certain instances, well-known details are not described in order to avoid obscuring the description. Further, various modifications may be made without deviating from the scope of the invention. For example, though the embodiments illustrate discovering décor such as artworks, décor of a room, the decor is not limited to artworks or décor of a room. The décor can include one or more of décor items such as paintings, pictures, artifacts, sound, architectural pieces, arrangement of artworks, color selection, rugs, mats, furnishings, clothes, jewelry, fashion, car interiors, flower arrangement, garden etc. Accordingly, the invention is not limited except as by the appended claims.

Reference in this specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the disclosure. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Moreover, various features are described which may be exhibited by some embodiments and not by others. Similarly, various requirements are described which may be requirements for some embodiments but not for other embodiments.

The terms used in this specification generally have their ordinary meanings in the art, within the context of the disclosure, and in the specific context where each term is used. Certain terms that are used to describe the disclosure are discussed below, or elsewhere in the specification, to provide additional guidance to the practitioner regarding the description of the disclosure. For convenience, certain terms may be highlighted, for example using italics and/or quotation marks. The use of highlighting has no influence on the scope and meaning of a term; the scope and meaning of a term is the same, in the same context, whether or not it is highlighted. It will be appreciated that the same thing can be said in more than one way. One will recognize that "memory" is one form of a "storage" and that the terms may on occasion be used interchangeably.

Consequently, alternative language and synonyms may be used for any one or more of the terms discussed herein, nor is any special significance to be placed upon whether or not a term is elaborated or discussed herein. Synonyms for certain terms are provided. A recital of one or more synonyms does not exclude the use of other synonyms. The use of examples anywhere in this specification including examples of any term discussed herein is illustrative only, and is not intended to further limit the scope and meaning of the disclosure or of any exemplified term. Likewise, the disclosure is not limited to various embodiments given in this specification.

Those skilled in the art will appreciate that the logic illustrated in each of the flow diagrams discussed above, may be altered in various ways. For example, the order of the logic may be rearranged, substeps may be performed in parallel, illustrated logic may be omitted; other logic may be included, etc.

Without intent to further limit the scope of the disclosure, examples of instruments, apparatus, methods and their related results according to the embodiments of the present disclosure are given below. Note that titles or subtitles may be used in the examples for convenience of a reader, which in no way should limit the scope of the disclosure. Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure pertains. In the case of conflict, the present document, including definitions will control.

What is claimed is:

1. A method for providing and managing a décor style classifier dictionary database, the method comprising:

receiving, at a computer system and from a first plurality of sources, a first plurality of images of a plurality of décors, the plurality of décors being of a plurality of décor styles;

receiving, at the computer system and from the first plurality of sources, a description indicative of the décor styles;

determining, by the computer system, a signature of a particular décor style of the plurality of décor styles based on analysis of the first plurality of images and the description, the determining the signature including:

determining a first plurality of features of an image of the first plurality of images, the image corresponding to the particular décor style, the first plurality of features including a design of décor items in the image, and

determining, using the description, a first plurality of keywords indicative of the particular décor style;

generating, by the computer system, a décor style classifier that is indicative of the particular décor style, the generating including associating the signature of the particular decor style with the décor style classifier, the décor style classifier to be used for determining décor items that match the particular décor style; and

storing the décor style classifier in a décor style classifier dictionary database, the décor style classifier dictionary database including a plurality of décor style classifiers corresponding to the décor styles.

2. The method of claim **1**, wherein determining the first plurality of features of the image includes determining morphological features of the image.

3. The method of claim **1**, wherein determining the first plurality of features of the image includes determining a color pattern of the image.

4. The method of claim **1**, wherein determining the first plurality of keywords describing the particular décor style further includes:

determining additional keywords corresponding to a metadata of the image that describes the particular décor style, and

associating the additional keywords with the décor style classifier.

5. The method of claim **1**, wherein determining the first plurality of keywords further includes:

determining, from a second plurality of sources, additional keywords that are semantically same as the first plurality of keywords, and

associating the additional keywords with the décor style classifier.

6. The method of claim **1** further comprising:

determining, using a recommendation engine, whether to associate the décor style classifier with a set of features and a set of keywords indicative of the particular décor style, and

associating the décor style classifier with the set of features and the set of keywords based on the recommendation engine.

7. The method of claim **6**, wherein the recommendation engine includes a rules-based expert system, the rules-based expert system including:

a plurality of rules for determining the décor style classifiers based on a second plurality of features of a second

plurality of images representing the plurality of décors of the plurality of décor styles and a second plurality of keywords indicative of the plurality of décor styles, the set of features and the set of keywords being a subset of the second plurality of features and the second plurality of keywords, respectively, and

wherein the associating includes associating the décor style classifier with the set of features and the set of keywords based on the plurality of rules.

8. The method of claim **7**, wherein associating the set of features and the set of keywords with the décor style classifier using the rules-based expert system further includes:

tracking, by the rules-based expert system, a style preference data of a plurality of users for the décor style classifier, and

updating, by the rules-based expert system, the set of features and the set of keywords associated with the décor style classifier based on the style preference data, the updating including associating a weight with each feature of the set of features and each keyword of the set of keywords that indicates a degree of match of a particular feature or keyword with the particular décor style.

9. The method of claim **6**, wherein the recommendation engine includes a clustering engine to:

create a first set of clusters based on a second plurality of features of a second plurality of images representing the plurality of décors of the plurality of décor styles, each cluster of the first set of clusters including a subset of the second plurality of features representing a specific décor style,

create a second set of clusters based on a second plurality of keywords indicative of the plurality of décor styles, each cluster of the second set of clusters including a subset of the second plurality of keywords representing the specific décor style,

associate a first cluster from the first set of clusters that has the set of features with the décor style classifier, and

associate a second cluster from the second set of clusters that has the set of keywords with the décor style classifier.

10. The method of claim **1** further comprising:

indexing the first plurality of images and the first plurality of keywords based on the décor style classifiers they are associated with; and

assigning style probabilities to the first plurality of images, the style probabilities indicating a probability of a particular image belonging to the décor styles corresponding to the décor style classifiers.

11. The method of claim **1** further comprising:

receiving, at the computer system and from a user, a user input including data indicative of a required décor style, the user input including at least one of a second image or a second plurality of keywords describing the required décor style;

analyzing, at the computer system, the user input to identify a target décor style classifier from the décor style classifier dictionary database that corresponds to at least one of the second image or the second plurality of keywords; and

identifying the target décor style classifier based on the analysis.

12. The method of claim **11**, wherein analyzing the user input includes at least one of (a) comparing the second plurality of keywords of the user input with the first plurality of keywords from the décor style classifier dictionary database or (b) comparing a plurality of features of the second image with the first plurality of features from the décor style classifier dictionary.

13. The method of claim **12**, wherein the comparing the second plurality of keywords of the user input with the first plurality of keywords from the décor style classifier dictionary database includes:

determining whether there is match between the second plurality of keywords and the first plurality of keywords,

responsive to a determination that there is no match, presenting, to the user, a subset of the first plurality of keywords from the décor style classifier dictionary database that is probably relevant to or is semantically similar to the second plurality of keywords of the user input,

receiving a user selection of the subset of the first plurality of keywords, and

identifying the décor style classifier corresponding to the user selection of the subset of the first plurality of keywords.

14. The method of claim **11** further comprising:

generating, in response to a request from the user to generate a plurality of color palettes corresponding to the target décor style classifier, the color palettes, wherein the color palettes is generated based on color patterns associated with the target décor style classifier.

15. The method of claim **1**, wherein the décor style includes at least one of (a) a concept of the décor, (b) a category of the décor, or (c) a mood associated with décor.

16. A method comprising:

receiving, at a computer system, a request for generating a plurality of color palettes for a décor, the request including user data indicative of a décor style;

analyzing, by the computer system, the user data to identify a décor style classifier from a décor style classifier dictionary database containing a plurality of décor style classifiers corresponding to a plurality of décor styles, the décor style classifier corresponding to the décor style; and

generating, by the computer system, the color palettes corresponding to the décor style classifier.

17. The method of claim **16**, wherein the user data indicative of the decor style includes a plurality or keywords or phrases.

18. The method of claim **17**, wherein analyzing the user data to identify the décor style classifier from a décor style classifier dictionary database includes:

comparing the keywords or phrases from the user data with a set of keywords or phrases in the décor style classifier dictionary database, and

identifying the décor style classifier corresponding to the set of keywords or phrases in the décor style classifier dictionary database that match with the keywords or phrases from the user data.

19. The method of claim **18**, wherein comparing the keywords or phrases from the user data with the set of keywords or phrases in the décor style classifier dictionary includes comparing the keywords or phrases from the user data with the set of keywords or phrases in the décor style classifier dictionary database semantically.

20. The method of claim **16**, wherein identifying the décor style classifier from a décor style classifier dictionary includes creating the décor style classifier dictionary database, the creating including:

receiving, by the computer system, content from a first plurality of sources, the content including (a) a first plurality of images corresponding to a plurality of

décors of the plurality of décor styles, and (b) a description indicative of the décor styles,

determining, by the computer system, a signature of a particular décor style, the signature including (a) a first plurality of colors of an image of the images, the image corresponding to the particular décor style and (b) a first plurality of keywords indicative of the particular décor style, and

adding a new décor style classifier corresponding to the particular décor style to the decor style classifier dictionary database and associating the signature with the new decor style classifier.

21. The method of claim **20**, wherein adding the new décor style classifier includes:

determining whether the décor style classifier dictionary database includes the new decor style classifier, and

responsive to the determination that the décor style classifier dictionary database includes the new décor style classifier, updating the new décor style classifier to include the first plurality of colors and the first plurality of keywords.

22. The method of claim **21** further comprising:

determining a set of colors to be associated with a particular décor style classifier using a rules-based expert system, the rules-based expert system including data regarding the décor style classifiers and a plurality of colors associated with each of the décor style classifiers as a plurality of rules, the set of colors indicative of a style of the décor corresponding to the particular décor style classifier, the set of colors being a subset of the plurality of colors; and

associating the particular décor style classifier in the dictionary database with the set of colors based on the plurality of rules.

23. The method of claim **22**, wherein associating the set of colors with the particular décor style classifier using the rules-based expert system further includes:

tracking, by the rules-based expert system, color preference data of a plurality of users for the particular décor style classifier, and

updating, by the rules-based expert system, the set of colors associated with the particular décor style classifier based on the color preference data, the updating including associating a weight with each of the set of colors that indicates a degree of match of a particular color with the particular style.

24. A non-transitory computer-readable medium storing program instructions that, when executed by a processor, causes the processor to perform a method of: receiving, at a computer system, content from a first plurality of sources, the content including (a) a first plurality of images of a plurality of décors, the plurality of décors being of a plurality of décor styles, and (b) a description indicative of the decor styles;

determining, by the computer system, a signature of a particular décor style from the plurality of décor styles, the signature including (a) a first plurality of features of an image of the images, the image corresponding to the particular décor style, the first plurality of features including a design of décor items in the image, and (b) a first plurality of keywords indicative of the particular décor style; and

generating, by the computer system, a décor style classifier in a décor style classifier dictionary database, the décor style classifier dictionary database including a plurality of décor style classifiers corresponding to the décor styles, the generating including associating the signature with the décor style classifier.

25. An apparatus for providing and managing a décor style classifier dictionary database, the apparatus comprising:

a processor;

a style dictionary creation module that works in co-operation with the processor to create a décor style dictionary database containing a plurality of décor style classifiers that correspond to a plurality of décor styles, each of the plurality of décor style classifiers associated with a signature defining a particular décor style of the plurality of décor styles;

a style analysis module that works in co-operation with the processor to determine the signature of the particular décor style, the signature including (a) a plurality of features of an image corresponding to the particular décor style, the plurality of features including a design of décor items in the image, and (b) a plurality of keywords indicative of the particular décor style; and

an expert system that works in co-operation with the processor to track style preference data of a plurality of users for each of the décor style classifiers and associate a weight with each of the plurality of features and each of the plurality of keywords of each of the décor style classifiers, the weight indicating a degree of match of a particular feature or keyword with the particular décor style.

26. A method for creating a décor of a particular décor style, the method comprising:

receiving, at a computer system and from a user, data specifying a particular décor type of the décor and the particular décor style that are used for creating the décor;

analyzing, at the computer system, the data to identify a set of features or a set of keywords that are indicative of the particular décor style;

retrieving, from a décor style classifier dictionary database, a décor style classifier whose signature matches with the set of features or the set of keywords, the signature including at least one of (a) a first plurality of features representative of the décor of the particular décor style and the particular décor type, the first plurality of features including a design of décor items in the décor, or (b) a second plurality of features that are to be excluded from the décor for the décor to conform to the particular décor style, the décor style classifier dictionary database including a plurality of décor style classifiers corresponding to a plurality of décor styles; and

generating, by the computer system, recommendations regarding creating the décor of the particular décor type and the particular décor style, the recommendations generated based on the décor style classifier, the recommendations including at least one of (a) at least a subset of the first plurality of features to be considered for creating the décor or (b) at least a subset of the second plurality of features to be excluded from the décor.

27. The method of claim **26**, wherein the first plurality of features includes at least one of décor items in the décor, a placement of the décor items, color pattern of the décor, or color of the décor items.

28. The method of claim **27**, wherein the first plurality of features are determined using morphological analysis of one or more images representing a plurality of decors of the particular décor style and the particular décor type.

29. The method of claim **26**, wherein the particular décor type includes at least one of (a) home décor, (b) fashion, (c) artworks, (d) paintings, (e) clothes, (f) jewelry, (g) car interiors, or (h) flower arrangement.

30. The method of claim **26**, wherein the recommendations are presented as at least one of (a) a plurality of images, each

of the images representative of the decor based on one of the recommendations or (b) a plurality of words describing each of the recommendations.

31. The method of claim **1**, wherein the first plurality of sources includes any of a website, a journal, a blog, a document, or a magazine that includes content relevant to the décor styles.

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